RULES AND REGULATIONS
For the Six Year Integrated B.Tech Programme

(Comprising of 2-Year Pre-University course and 4-Year B.Tech Programme)

(w.e.f Academic Year 2016 – 17)

Note:

1. All the Rules and Regulations, hereinafter specified shall be read as a whole for the purpose of interpretation.
2. Any reference to PUC in these Rules and Regulations stands for Pre-University Course.

I. ADMISSION

1. Admissions to the 1st year of 6-Year integrated B.Tech Program will be based on merit in the Grade Point Average (GPA) and Grade obtained in each subject of SSC (10th class) or any other equivalent examination recognized by the state and by following the statutory reservations of the State. A deprivation score of 0.4 prescribed by the state Government under Statute 13 (3) shall be added to the 10th class GPA of those applicants who studied in non-residential Government Schools including the Zillaparishad and Municipal Schools, with an objective of providing weightage to the socio economically challenged students in the admission process.
2. At RGUKT-Basar, admissions to 85% of the total available seats shall be reserved for the Local Candidates (Telangana State) and the remaining 15% of the seats shall be un-reserved (these seats will be filled with students from both States of Telangana and Andhra Pradesh based on merit) as specified in the Presidential Order 371 Article D in consonance to Section 95 of the A.P. Reorganization Act, 2014.

II. DURATION AND PROGRAM OF STUDY

1. The duration of the Six Year Integrated Program is of twelve semesters. Each academic year comprises of two semesters. The first part of the six-year program comprises of 2-Year Pre University Course (PUC) of 4 semesters followed by a second part of 4-Year Bachelor of Technology (B.Tech) course of 8 semesters. Each semester comprises of

Instruction period	----- 16 weeks
Preparation holidays (includes practical exams)	----- 2 weeks

- No admission is made after the counselling process is completed. In case of any vacant seat, admission will be given to the student as per the merit within the four weeks of the commencement of instruction.
- No readmission/promotion is to be made after four weeks of the commencement of instruction.
- In case there are any court cases consequent to which the authorities are compelled to admit any candidate after the announced last date of admissions, the admission (seat) of such a student will be reserved for the subsequent year on a supernumerary basis.
- No refund of tuition fee will be made for the students withdrawing the admission from the University after the commencement of instruction.

2. The following programs of study are offered for the students admitted into 6-Year integrated B.Tech programme in the University.

- PUC (Common to all students during the first 2years of 6years integrated program)
- Below are the following B.Tech programs offered in the university upon completion of PUC
    i. Chemical Engineering
    ii. Civil Engineering
    iii. Computer Science and Engineering
    iv. Electrical and Electronics Engineering
    v. Electronics and Communications Engineering
    vi. Mechanical Engineering
    vii. Metallurgical and Materials Engineering

The schedule of study of all programs is regulated by the Academic Council / Boards of Studies of the University.

3. Each candidate will be admitted into the PUC at the time of admission, strictly depending on the merit secured in the qualifying examination (10th class or any other equivalent examination recognized by the state), and subject to the rules in force regarding reservations of seats. Upon the successful completion of the PUC, candidates will be admitted into any of the 4-Year B.Tech Program strictly depending on the merit(CGPA) secured at the end of PUC, and subject to the rules in force regarding reservations of seats.
4. Candidate who fails to fulfill all the requirements for the award of the degree as specified hereinafter within

    a) Eight academic years from the time of admission,

    b) He/she has to complete the 2-Year PUC within a maximum period of 3 years from the time of admission,

    c) He/she has to complete the 4-Year B.Tech course within a maximum period of 6 years from the time of branch allocation into 1st year of B.Tech program.

    If either of the cases mentioned in 4(a) or 4(b) or 4(c) is not satisfied, he/she will forfeit his/her seat in the program and his/her admission will stand cancelled automatically.

III. ALLOCATION OF SEATS IN ENGINEERING BRANCHES

A branch of engineering will be allocated for only those who pass in the 2-Year PUC with a minimum CGPA of 6 and above. The allocation of engineering branch shall be made on the choice of the students and by resolving based on their performance in the PUC as per the following procedure:

i. Choice of the students in order of preference going up to all 7 choices will be collected on-line.

ii. RGUKT will take the overall CGPA of the students who have passed in the PUC by meeting the minimum CGPA of >=6 and will put the students in order of merit in each of the reserved categories and allocate the seats as per the merit order considering the no of seats available in each of the branches for each of the categories of reservation.

In case of tie on account of same CGPA, the tie will be resolved to decide the relative ranking based on the following criterion:

1. Average grade in Mathematics courses of four semesters of PUC.
2. Next, average grade in Physics courses of four semesters of PUC.
3. If the tie still persists, candidate older (based on date of birth) will be given preference over the younger.

iii. The no of seats available in Engineering branches will be decided considering the total no of students passing the PUC with a minimum CGPA of >=6 (after taking the remedial examination after 2nd Semester of 2nd Year PUC into consideration) and going by the following ratio (for a total of 1000 seats):

Chemical Engineering	71/1000 @ 7.1 per 100 seats
Civil Engineering	143/1000 @ 14.3 per 100 seats
Computer Science and Engineering	214/1000 @ 21.4 per 100 seats
Electrical and Electronics Engineering	144/1000 @ 14.4 per 100 seats
Electronics and Communication Engineering	214/1000 @ 21.4 per 100 seats
Mechanical Engineering	143/1000 @ 14.3 per 100 seats
Metallurgical and Materials Engineering	71/1000 @ 7.1 per 100 seats

IV. RULES AND REGULATIONS OF ATTENDANCE

1. Candidates admitted to a particular program of study are required to pursue a "Regular Program of study" before they are permitted to appear for the University Examination.

2. "A regular program of study" means putting in attendance of not less than 75%.

3. a) In special cases and for valid medical reason, the Vice–Chancellor may on the specific recommendation of the Director / Head of the Department, condone the deficiency in attendance to the extent of 10% on medical grounds subject to submission of medical certificate and payment of condonation fee.

   b) However, in respect of women candidates who seek condonation of attendance due to pregnancy, the Vice–Chancellor may condone the deficiency in attendance to the extent of 15% (as against 10% condonation for others) on medical grounds subject to submission of medical certificate to this effect. Such condonation shall not be more than once during the program of study.

4. The fees for condonation of attendance on medical grounds shall be Rs. 500/- payable through Demand Draft drawn/Bank challan paid in favor of the Director, RGUKT-Basar.

5. Medical absence of up to one academic year may be granted against submission of genuine documents and on an undertaking by student and parent/guardian that the absence is not taken for undergoing any coaching for any entrance test or for joining elsewhere, with the approval of the Dean (Academics).

6. The student's name will be removed from the rolls, if the medical absence is more than one academic year. However, in genuine cases, an absence of more than one year and up to a maximum period of two years can be granted by the Academic Council on prior application to only those students who were studying beyond the first year of Engineering.

7. "Attendance of NCC/NSS camps or Inter Collegiate or Inter University or Inter State or International matches or debates or Educational Excursions or such other Inter University activities as approved by the authorities involving journeys outside the city in which college is situated will not be counted as absence. However, such 'absence shall not exceed (2) weeks per semester of the total period of instructions. Such leave can be availed only once during the 6-Year integrated programme of study.

8. The attendance shall be calculated on the aggregate of the papers/courses from the date of commencement of classes/date of readmission in case of detained candidates as per the almanac communicated by the University.

9. In case of the candidates who failed to put in the required attendance in a program of study, he/she shall be detained in the same class and will not be permitted to appear for the University Examination. Such

candidates shall have to seek readmission into the same class during the subsequent year in order to appear for the examination after fulfilling the attendance requirements, and on payment of requisite fee as applicable.

10. a) Candidates admitted either to the first year of PUC or first year of 4-Year B.Tech program from the Academic Year 16-17, who do not have the requisite attendance in the first year of PUC or first year of 4-Year B.Tech program, but have not less than 40% attendance, can seek readmission into the same class during the subsequent year in order to appear for the examination after fulfilling the attendance requirements, and on payment of requisite fee as applicable.

    b) In respect of candidates admitted to the first year of PUC, who do not have the minimum 40% attendance will lose their admission and he/she has to leave the university with their SSC certificates only. In case of candidates admitted to the first year of B.Tech program after PUC, who do not have the minimum 40% attendance will lose their admission from the concerned B.Tech program and he/she has to leave the university with the PUC certificates.

V. REGULATIONS FOR GRANTING WITHDRAWAL ON MEDICAL GROUNDS AND TAKING RE-ADMISSION

1. A student may be permitted to withdraw temporarily for a period of one semester or more from the university on the grounds of prolonged illness or acute problem in the family which compelled him/her to stay at home, provided:

    a) He/she applies to the University within 15 days of the commencement of the semester or from the date he/she last attended his/her classes whichever is later, stating fully the reasons for such withdrawal together with supporting documents and endorsement of the father/guardian.

    b) Permission is granted if the Institute is satisfied that, inclusive of the period of withdrawal, the student is likely to complete his requirements for the degree within the time limits as mentioned in the point no(4) of DURATION AND PROGRAM OF STUDY.

    c) The student should submit an undertaking letter duly signed by the student and parent/guardian indicating that absence was not taken for undergoing any coaching for any entrance test or joining elsewhere, with the approval of the Dean (Academics).

    d) A student who is granted medical withdrawal shall go for re-admission into the same semester along with the subsequent year students.

2. A student will be granted only one such temporary withdrawal during his/her tenure as a student of the University.

3. Students who are readmitted on medical grounds or other extraordinary ground will have to pay their mess fee for the period of days present for the semester during which the student has discontinued, besides the regular fee payable for the year in the discontinued semester or long absence on medical grounds.

4. The long absence cases on medical grounds should be recommended by a medical board under the chairmanship of the Dean (academics).

5. Students shall seek prior permission for granting withdrawal on medical grounds and taking readmission in the same semester from which discontinued along with subsequent year students.

- **Rules for re-admitted students**

  Students who are readmitted on medical grounds or other extraordinary grounds will have to pay their mess and accommodation charges of Rs.100/- per day, for the period of days present for the semester during which the student has discontinued, besides the regular fee payable for the year. Readmitted students will have to pay a registration fee of Rs.1000/- (Rs.500/- for SC and ST categories only) irrespective of the semester in which the candidate seeks readmission, in addition to the regular annual fee of Rs. 36,000/- for PUC and Rs.40,000/- for B.Tech programmes and any other miscellaneous fees(examination fees etc., if applicable).

VI. SCHEME OF INSTRUCTION AND EXAMINATION

1. Instruction to the various courses in each semester of the six-year integrated program, shall be provided by the University as per the schemes of instructions and syllabi prescribed in the syllabus book.

2. The distribution of marks / grade* for courses based on Continuous Internal Evaluation (CIE) and the End Semester Examination (ESE) shall be as follows.

Subject	Continuous Internal Evaluation (CIE)	End Semester Examination (ESE)
Each theory subject	40	60
Each Laboratory	40	60
Each drawing subject/Lab	50	50
Seminar	--	100
Comprehensive Viva	--	100
Internship	--	100
Project	--	100

*Grades are allotted based on the marks secured in Continuous Internal Evaluation and End Semester Examination as per the following criteria.

- The evaluation of each theory subject for maximum of 100 marks will be done as per guidelines given below:

  i. Out of 40 internal marks of theory subject, 10 marks are for the Assignments/Tutorials/Quizzes etc., in the course, the rest of the 30 marks are based on Monthly Tests; weightage for each monthly test is 15 marks, out of which Five marks for Part-A consisting of objective and short answer questions and 10 marks for Part-B consisting of subjective questions.

  ii. Three Monthly tests will be conducted in each semester. Best 2 out of 3 Monthly Tests is considered in evaluation for 30 marks and 10 marks is awarded based on the assignments given in the particular course from time to time (At least three assignments to be given in engineering subjects and at least six assignments to be given in PUC subjects).

  iii. Out of 60 marks end semester examination of theory subject, question paper consists of subjective questions covering all the units of the syllabus.

- The evaluation of each Laboratory for maximum of 100 marks will be done as per the guidelines given below:

  i. Out of 40 internal marks of laboratory; 10 Marks are for Internal Viva-voce, 30 marks for Record, Observation Book, Attendance and Assessment of the student during the Regular Lab Sessions.

  ii. Out of 60 marks external in laboratory, 20 Marks are for External Viva-voce and 40 Marks for Lab Examination (for performing the experiment in the exam).

- The evaluation of each Drawing course for maximum of 100 marks will be done as per guidelines given below:

  i. Out of 50 internal marks of drawing course; 25 marks are for drawing sheets drawn during the course, 25 marks for mid semester evaluation which can be a manual/software tool based drawing/subjective type examination.

  ii. Out of 50 marks end semester examination of drawing course, question paper consists of questions covering all the units of the syllabus which is completely a manual drawing type examination.

- The evaluation of Internship for maximum of 100 marks will be done as per guidelines given below:

  i. 30 marks are allocated for the evaluation by supervisor from the hosting organization where the student has performed his/her internship work.

  ii. 30 marks are allocated for the report for the quality of the internship work covering (a) Literature Review, (b) Innovation / Originality, (c) Methodology and (d) Relevance / Practical application.

  iii. 40 marks for candidate's performance in internship presentation and viva-voce.

- The evaluation of B.Tech project for maximum of 100 marks will be done as per guidelines given below:

  i. 20 marks are allocated for Mid-term presentation, Viva-voce and brief 3-4 pages of report writing / Documentation.

  ii. 40 marks are allocated for Supervisor's evaluation of the work and report at the end of the semester for the quality of the project work covering (a) Literature Review, (b) Innovation / Originality, (c) Methodology and (d) Relevance / Practical application.

  iii. 40 marks for candidate's performance in End-semester project presentation and viva-voce.

Note: A course that has no credits will still have the same scheme of evaluation mentioned against theory course in the table. However, student has to compulsorily pass in such courses where no credits are allocated. Grading in such courses will be either 'P' (Pass) or 'R' (Remedial).

3. The details of instruction period (Time table), examination schedule, vacation etc., shall be notified by the Vice Chancellor/Director of the University.

4. The medium of instruction and examination shall be in English apart from the material related to Telugu course in PUC.

5. At the end of each semester, End Semester Examination shall be conducted as prescribed in the respective schemes of examination. The examination pertaining to the semester just ended will be called; main examinations and the examination pertaining to the other semesters will be called supplementary/remedial examinations.

6. To enable the B.Tech Final year students to complete the program requirements in time, there shall be a Make-Up Exam (remedial exam), for B.Tech VIII semester only, which is scheduled within one month on publication of results of VIII semester Main Examinations.

7. The examinations prescribed may be conducted by means of written papers, practical and oral tests, inspection of certified sessional work in Drawing and Laboratories and Workshop, or by means of any combination of these methods as may be deemed necessary.

   Candidates will be required to produce complete lab records of the practical work done by them in each practical examination, along with observation book and other materials prepared or collected as part of Lab Work / Project.

8. All the general rules for examinations (given under section XI) shall be adhered to.

VII. GRADING SYSTEM AND AWARD OF DIVISION

1. **For the PUC program of the 6-year integrated course, an absolute grading system is used to award grades to students. The grading table is given below for PUC program:**

S. No	Performance	Marks Range	Letter Grade	Grade point value per credit
1	Excellent	90 – 100	Ex	10
2	Very good	80 – 89	A	9
3	Good	70 – 79	B	8
4	Fair	60 – 69	C	7
5	Average	50 – 59	D	6
6	Pass	40-49	P	5
7	Remedial / Fail	< 40	R	0

i. Highest possible CGPA in the system is 10.00

ii. Pass Requirements:

- Below mentioned minimum marks for Pass are applicable for the students admitted into PUC from the academic year 2016-17.
  a. Theory – A minimum of 40% marks in end semester examination and an overall of minimum 40% marks in the ESE plus CIE (i.e., P grade)
  b. Laboratory - A minimum of 50% marks in end semester examination and an overall of minimum 50% marks in the ESE plus CIE (i.e., D grade)

If a candidate in any semester examination of the program fails to secure the minimum marks/grade in any subject, then he/she shall have to appear for supplementary/remedial examination only in the failed subject of the semester.

- Below mentioned minimum marks for Pass are applicable for the students admitted into PUC before the academic year 2016-17.
  a. Theory – Minimum 40% marks in the ESE plus CIE (i.e., P grade)
  b. Laboratory - Minimum 40% marks in the ESE plus CIE (i.e., P grade)

If a candidate in any semester examination of the program fails to secure the minimum marks/grade in any subject, then he/she shall have to appear for supplementary/remedial examination only in the failed subject of the semester.

iii. For results evaluated using the Absolute Grading method for PUC batches, results are to be moderated by a Committee convened by the Controller of Examinations. The Committee comprises of the following:

a) Vice Chancellor / Director - Chairman

b) Dean (Academics) - Member

c) Head of the Department of concerned subject – Member

d) Concerned subject faculty - Member

e) Controller of Examinations – Convener

iv. The method for moderating the PUC results consists of the following:
Moderation of Marks is adopted provided the percentage of remedial students in that subject is greater than 10%. The method of moderation is as follows;

a) If the percentage of students falling into A-grade plus Ex-grade is greater than or equal to 20%, no moderation is adopted.

b) If the percentage of students falling into A-grade plus Ex-grade is lesser than 20%, the grade moderation shall be done in that subject as follows.

i) Add 1 mark to all the students and re-evaluate the percentage of students getting A-grade plus Ex-grade. No further addition of marks is needed if the percentage of students falling into A-grade plus Ex-grade is greater than or equal to 20%.

ii) On the other hand, moderation is continued following step (i) above till the percentage of students falling into A-grade plus Ex-grade is greater than or equal to 20% (or) till a maximum of 5 marks are added , whichever is earlier, irrespective of percentage of students falling into remedial grade.

2. For the engineering streams of the 6-year integrated course

I. The below mentioned grading system is applicable for the students admitted into 4-Year B.Tech programme from the academic year 2016-17. An absolute grading system is used to award grades to students. The grading table is given below:

S. No	Performance	Marks Range	Letter Grade	Grade point value per credit
1	Excellent	90 – 100	Ex	10
2	Very good	80 – 89	A	9
3	Good	70 – 79	B	8
4	Fair	60 – 69	C	7
5	Average	50 – 59	D	6
6	Pass	40-49	P	5
7	Remedial / Fail	< 40	R	0

i. Highest possible CGPA in the system is 10.00

ii. Pass Requirements:

a. Theory – A minimum of 40% marks in end semester examination and an overall of minimum 40% marks in the ESE plus CIE (i.e., P grade)

b. Laboratory - A minimum of 50% marks in end semester examination and an overall of minimum 50% marks in the ESE plus CIE (i.e., D grade)

c. Internship/Project/Comprehensive Viva/Seminar - A minimum of 50% marks in the overall evaluation (i.e., D grade)

iii. For results evaluated using the Absolute Grading method for B.Tech streams, results are to be moderated by a Committee convened by the Controller of Examinations. The Committee comprises of the following:

a) Vice Chancellor / Director – Chairman

b) Dean (Academics) – Member

c) Head of the Department – Member

d) Concerned subject faculty – Member

e) Controller of Examinations – Convener

iv. The method for moderating the PUC results consists of the following:

Moderation of Marks is adopted provided the percentage of remedial students in that subject is greater than 15%. The method of moderation is as follows;

a) If the percentage of students falling into A-grade plus Ex-grade is greater than or equal to 20%, no moderation is adopted.

b) If the percentage of students falling into A-grade plus Ex-grade is lesser than 20%, the grade moderation shall be done in that subject as follows.

i) Add 1 mark to all the students and re-evaluate the percentage of students getting A-grade plus Ex-grade. No further addition of marks is needed if the percentage of students falling into A-grade plus Ex-grade is greater than or equal to 20%.

ii) On the other hand, moderation is continued following step (i) above till the percentage of students falling into A-grade plus Ex-grade is greater than or equal to 20% (or) till a maximum of 5 marks are added , whichever is earlier, irrespective of percentage of students falling into remedial grade.

II. The below mentioned grading system is applicable for the students admitted into 4-Year B.Tech programme before the academic year 2016-17. University follows a combination of absolute and relative grading for evaluation and award of grades. The grade cut-off for the absolute grading is shown as below:

S. No	**Marks Range**	**Grade**	**Grade points per credit**
1	90 – 100	Ex	10
2	80 – 89	A	9
3	70 – 79	B	8
4	60 – 69	C	7
5	50 – 59	D	6
6	< 50	R	0

i. Highest possible CGPA in the system is 10.00

ii. Pass Requirements: Minimum marks for Pass

a. Theory: - 50% or cut-off for D-grade, whichever is lower.

b. Laboratory/Internship/Project/Comprehensive Viva/Seminar: - 50% or cut-off for D-grade, whichever is lower.

The process for awarding the grades in engineering streams is then as follows:

i. In each subject marks awarded are compiled into cumulative frequency table.

ii. A new cut off mark for each of the grades is obtained following the relative grading system on the basis of the above mentioned percentage number of students expected to fall in each grade. For example, the mark of the student who is at the border of the top 5% of students will be the relative grading cut-off mark for 'Ex' grade. Similarly, the marks of the student who is at the border of the next 20% of students will be the relative grading cut-off mark for 'A' grade and so on.

iii. New cut off marks for awarding the grades are obtained by comparing the relative grading cut-off marks to the absolute grading cut-off marks. The lower of the two is taken as the new cut-off mark, subject to a maximum deviation of 10 marks from the fixed grading system.

iv. In each case, the new cut-off is limited to ±10 marks from the cut-offs of the fixed grading system.

v. In case the fixed grading cut-off > relative grading cut-off > 10, then the new cut-off is obtained as fixed grading cut-off – 10.

3. Semester Grade Point Average (SGPA) & Cumulative Grade Point Average (CGPA) calculation:

- **Calculation of SGPA**

A semester Grade Point Average (SGPA) will be computed for each semester. The SGPA will be calculated as follows:

$$SGPA = \frac{\sum^{n} Ci \times GPi}{\sum^{n} Ci}$$

Where, Ci = Credit for the course, GPi = the Grade Point obtained for the course and the summation over all the courses taken in that semester and 'n' is the number of subjects registered for the semester.

- **Calculation of CGPA**

A Cumulative Grade Point Average (CGPA) will be computed for every student at the end of each semester. The CGPA would give the cumulative performance of a student from the first semester upto the end of the semester to which it refers and calculated as follows.

$$CGPA = \frac{\sum^{m} Si \times Ci}{\sum^{m} Ci}$$

Where 'm' is the total number of semesters under consideration. Ci the total number of credit registered for during a particular semester and Si is the SGPA of that semester. Both SGPA and CGPA will be rounded off to the second place of decimal and recorded as such.

When a student gets the 'R' grade in any subject during a semester, the SGPA and the CGPA from that semester onwards will be tentatively calculated, taking only 'zero point' for each such 'R' grade. After the 'R' grade has been substituted by better grades during a subsequent remedial examination the SGPA and CGPA of all the semesters starting from the earliest semester in which the 'R' grade has been obtained, will be recomputed and recorded to take this change of grade into account.

4. Award of Division

- Below award of division is applicable for the students admitted into PUC and B.Tech stream from the academic year 2016-17.

S. No	CGPA Range	Class awarded	
		PUC	**Engineering**
1.	CGPA ≥ 8.00	Distinction	Distinction
2.	7.00 ≤ CGPA < 8.00	First Class	First class
3.	6.00 ≤ CGPA < 7.00	Second Class	Second Class
4.	5.00 ≤ CGPA < 6.00	Pass Class	Pass Class
5.	CGPA < 5.00	Remedial	Remedial

- Below award of division is applicable for the students admitted into PUC and B.Tech stream before the academic year 2016-17.

S.No	CGPA Range	Class awarded	
		PUC	**Engineering**
1.	CGPA ≥ 8.00	Distinction	Distinction
2.	7.00 ≤ CGPA < 8.00	First Class	First class
3.	6.00 ≤ CGPA < 7.00	Second Class	Second Class
4.	5.00 ≤ CGPA < 6.00	Pass Class	Remedial
5.	CGPA < 5.00	Remedial	Remedial

5. Student is eligible for distinction grade only when the CGPA is >= 8.00, provided he/she must have passed all the subjects in the single attempt.

6. Formula for Conversion of CGPA into equivalent percentage of marks

   Average percentage of marks = CGPA*10

7. Students can avail the revaluation facility

   a) Students must submit their application in a plain paper to the Director, indicating clearly the subjects in which revaluation is to be made.

   b) Application must be accompanied by a demand draft/bank challan drawn in favor of the Director towards the subject(s) opted for revaluation process @ Rs.100/- per subject.

   c) The application should be submitted within 15 days from the declaration of the results.

d) Results after the revaluation process will be declared following the academic regulations in force then.

e) In case of any changes in marks after revaluation is done, the higher of the original and revaluated marks will be taken as the final marks provided the difference in the marks is greater than or equal to 10% of the original marks. Else the original marks will remain.

8. Reduction in pass marks for PH students: Based on the prevailing orders from the Government, PH students under the category of Hearing Impaired, Orthopedically handicapped, Visually challenged, Deaf and dumb will be given a concession of 10% over pass marks.

VIII. AWARD OF DEGREE

RGUKT admits the selected candidates after their 10th class into the 6 - year integrated undergraduate engineering programme involving the combination of a Pre-University course (PUC) and a Bachelor's degree in Technology (B.Tech). All the students are expected to complete the full 6-year programme successfully. The students will get a PUC degree on successful completion of the 2-Year PUC programme and will get the B.Tech degree upon the successful completion of the 4-Year B.Tech programme.

Award of Gold Medal

i. A student securing highest CGPA in B.Tech programme in single attempt is eligible for award of University Gold Medal.

ii. A student securing highest CGPA in B.Tech programme in single attempt in the respective Engineering Discipline is eligible for award of Branch Wise Gold Medal.

IX. EXAMINATION FEES

a. Candidate's has to register/apply in the prescribed form to appear at every examination if he/she fulfills the requirement of attendance or any other and by paying the prescribed fee in the bank, in favor of the Director on or before the date fixed for this purpose.

• End Semester Examination	Rs. 500/- per semester
• Remedial Examination	Rs. 100/- per subject
• Grade Improvement Examination	Rs. 100/- per subject
• Revaluation	Rs. 100/- per subject

b. Fee Payable for Various Certificates

• Consolidated Marks Memo/Transcript	Rs.50/-each
• Transcript (Semester Wise)	Rs.20/-each
• Student Educational Verification	Rs.500/-each
• Correction in any Certificate	Rs.75/-each
• Original Degree Certificate	Rs.150/-
• Any correction in or re issue of Degree certificate	Rs.150/-
• Transfer Certificate	Rs.50/-
• Migration Certificate	Rs.50/-
• Identity Card	Rs.50/-

c. Student's can apply for the Photocopy of Theory Answer Script by paying Rs.1000/- per subject. Candidate who desire to apply for Revaluation should apply separately without waiting for the Photocopy of Answer Script.

X. RULES OF PROMOTION

1. Rules of promotion are as under for PUC:

Sl. No.	Regulations	
1	Promotion from PUC to B.Tech 1st Year	a) Students to enter into the B.Tech program should have obtained a CGPA of 6.00 or more by the end of the 4th semester of the PUC program. b) There should be no backlog of subjects and the student must have passed all the subjects from the 1st to the 4th semester of the PUC program.
2	Remedial and Grade improvement Examination	a) Such students who could not fulfil the promotion criteria from PUC to B.Tech 1st year will have an opportunity to write remedial examination in failed subjects and grade improvement examination in any number of passed subjects. b) Remedial students and Grade improvement students shall write only end semester examination for 60 marks. Internal assessment for 40 marks is carried over from the internal assessment test held already during regular semester. No separate internal assessment test will be held for this category. c) A maximum of two chances for grade improvement per subject shall be given to those students with < 50% marks (D Grade) for improving their overall CGPA in PUC. d) A maximum of one chance for grade improvement per subject shall be given to those students with > = 50% marks (D Grade) for improving their overall CGPA in PUC. e) The best grade obtained among all the examination taken in a given subject will be included in final marks sheet and for calculation of final CGPA.

		f) All remedial and grade improvement examinations will be conducted after the regular semester examinations.
3	PUC completion certificate (for those who want to exit at the end of PUC II Year	a) Minimum pass marks required in each subject is 40% (P-Grade). b) Students with a pass (40%-P Grade) in all the subjects but with a CGPA of more than or equal to 5 can either exit with a PUC pass certificate or can take grade improvement for improving his/her grades to become eligible for promotion to E1. c) Students may be given chance to improve their grades along with the remedial examination to become eligible for promotion to E1. d) First two years of 6 Year Integrated B.Tech Program, should be completed within a maximum period of 3 years to become eligible for the promotion into 4-Year B.Tech program. e) Students who fail to meet the promotion criteria to the B.Tech 1st year, but has satisfied the PUC pass requirements, should exit from the PUC program provided he/she passes in all the courses of PUC program within a maximum period of 4 years from the time of admission.

2. Rules of promotion are as under for B.Tech (The rules of promotion mentioned in the table are applicable for the students admitted into 4-Year B.Tech programme from the academic year 2016-17):

S. No.	**Semester/Class**	**Conditions to be fulfilled for Promotion**	
1.	From 1st Semester to 2nd Semester	Regular program of study of B.Tech 1st Semester	
	From 2nd Semester to 3rd Semester	a. Regular program of study of B.Tech 2nd Semester b. Must have earned at least 50% of credits prescribed for B.Tech 1st Semester and 2nd Semester put together. The number of credits a candidate can have as backlogs are as under.	
		No. of credits prescribed for 1st	No. of credits permitted as

		Sem and 2^{nd} Sem	backlogs*
		43/44	22
		45/46	23
		47/48	24
		49/50	25
		And so on as per credits	
2.	From 3^{rd} Semester to 4^{th} Semester	Regular program of study of B.Tech 3^{rd} Semester	
3.	From 4^{th} Semester to 5^{th} Semester	a. Regular program of study of B.Tech 4^{th} Semester b. No. of backlog credits, if any of B.Tech 1^{st}, 2^{nd}, 3^{rd} and 4^{th} Semester put together shall not exceed 50% of the total number of credits prescribed for the B.Tech 3^{rd} & 4^{th} Semester.	
		No. of credits prescribed for 3^{rd} & 4^{th} Semester	No. of credits permitted as backlogs
		45/46	23
		47/48	24
		49/50	25
		And so on as per credits	
4.	From 5^{th} Semester to 6^{th} Semester	Regular program of study of B.Tech 5^{th} Semester	
5.	From 6^{th} Semester to 7^{th} Semester	a. Regular program of study of B.Tech 6^{th} Semester b. No. of backlog credits, if any of B.Tech 1^{st} to 6^{th} Semester put together shall not exceed 50% of the total number of credits prescribed for the B.Tech 5^{th} & 6^{th} Semester.	
		No. of credits prescribed for 5^{th} &	No. of credits permitted as

		6th Semester	backlogs
		45/46	23
		47/48	24
		49/50	25
		And so on as per credits	
6.	From 7th Semester to 8th Semester	Regular program of study of B.Tech 7th Semester	

- Students who wish to improve his/her overall CGPA may do so within one academic year immediately after having passed all the examinations of the B.Tech program, by reappearing at not more than two semesters (all subjects pertaining to the semester taken together) examinations. For the award of the overall CGPA, he/she will have the benefit of the higher of the two aggregates of marks / grades secured in the corresponding semester(s).

Note:

i. If a candidate has more than permitted number of credits as backlogs in B.Tech, he/she will be detained. The candidate who wishes to take readmission into the year in which he/she is detained has to pay the total fee of that year and all the credits earned during that year shall become null and void.

ii. If the number of credits permitted as backlogs turned to be fraction, the credits are rounded to next higher digit.

3. Rules of promotion are as under for B.Tech (The rules of promotion mentioned in the table are applicable for the students admitted into 4-Year B.Tech programme before the academic year 2016-17):

S. No.	Regulations	
1	Criteria to be satisfied for promotion from B.Tech 1st Year to 2nd Year	Student must have passed all the subjects (including theory, labs) of B.Tech 1st Year.
2	Criteria to be satisfied for promotion from B.Tech 2nd Year to 3rd Year and 3rd year to 4th Year	No restriction. However a student has to complete the 6-Year integrated B.Tech Programme (2-Year PUC + 4-Year B.Tech) within a maximum period of 8 years from the date of admission (including 2 additional years)
3	Minimum CGPA required for the award of B.Tech degree	CGPA of 6.00 or more by the end of the 4th year of B.Tech program.

XI. REMEDIAL EXAMINATION RULES

1. Students with a remedial grade (R-Grade) will have to clear their backlogs by attending the remedial examinations whenever they are announced by the University.

2. Promotion into the engineering stream will not be possible for those students who do not clear their remedial backlog(s) in PUC.
3. No certificate – provisional or original – can be issued by the University to the students who have pending backlog in their PUC stream. A marks statement may be issued if applied for.
4. For all students attending remedial exams, the marks memorandum will reflect the grade earned in the subject with a '*' mark. For example, if the student obtains 'B' grade in a subject after attending the remedial exam, it will be shown as 'B*' in the memorandum of marks.
5. Moreover, for the purpose of evaluating the SGPA and the CGPA, the grade point for one grade lower than that obtained in the remedial exam will be considered. For example, if the student has obtained a 'B' grade, then the grade point of 'C' grade will be used for evaluating the SGPA. However, the grade point of lowest pass grade (P-grade or D-grade as per applicability) will not be lowered further.

XII. GENERAL RULES OF EXAMINATIONS

1. Candidate's has to register/apply in the prescribed form to appear at every examination if he/she fulfills the requirement of attendance or any other and by paying the prescribed fee if any, in the bank, in favor of the Director on or before the date fixed for this purpose.
2. When a candidate's application is found to be in order and he/she is eligible to appear at an Examination, the Controller of Examination shall issue him/her with a Hall-Ticket, enabling the candidate to appear in the Examination, and this Hall-Ticket shall have to be produced by the candidate in premises/exam hall where the Examination is conducted.
3. A candidate who does not present himself/herself for the examination for any reason whatsoever, excepting shortage of attendance, shall not be entitled to claim refund of the whole or part of the examination fee, for subsequent Examination(s).
4. A candidate after he/she has been declared successful in the whole examination, shall be given a provisional certificate setting forth year of examination, the subjects in which he/she were examined and, the overall grade secured. However, the candidates have to obtain degree certificate (convocation) from the University examination branch.
5. No candidate shall be allowed to put in attendance for a program or appear at examinations for different degrees and different faculties at one and the same time.
6. Students who have appeared once at any examination of the program need not put in fresh attendance, if they wish to reappear at the corresponding examination, notwithstanding the fact that the University may have introduced new course. They will, however, have to appear at the examinations according to the scheme of examination with any syllabi in force.
7. Students are expected to be in the exam hall on time. No student shall be allowed to enter the examination hall 15 minutes after the commencement of the examination.
8. Students are expected to strictly comply with the instructions given while in the examination hall. Non-compliance shall amount to malpractice and suitable action will be initiated.
9. Malpractice/copying is strictly prohibited during examinations. Students are advised not to indulge in any malpractice during examinations. If any student is found guilty of malpractice, he/she shall be penalized as per the decision of the Disciplinary Committee appointed by the Vice-Chancellor. He/she shall be debarred from appearing at the subsequent papers of the Examination apart from cancelling the result of the examination in which he/she had indulged in malpractice. Disciplinary Committee can even recommend for the rustication of the student(s) for a minimum duration of a semester or an academic year depending on the severity of the malpractice reported.

XIII. TRANSITORY REGULATIONS

Whenever a course or scheme of instruction is changed in a particular semester/year, two more examinations following thereafter shall be conducted according to the old syllabus/regulations/examination pattern. Candidates not appearing at the examinations or failing in them shall take the examination subsequently according to the changed syllabus/regulations/examination pattern.

XIV. RULES REGARDING CONDUCT AND DISCIPLINE

1. Students shall show due diligence to the teachers of the University, the Wardens of the Halls of Residence, the Sports Officers and the Officers of the National Cadet Corps; proper courtesy and consideration should be extended to the employees of the University and the Wardens of the hostels. They shall also pay due attention and courtesy to visitors.

2. Students are required to develop a friendly relationship with fellow students. In particular, they are expected to show kindness and consideration to the new students admitted to the University every year. Acts of ragging will be considered as gross indiscipline and will be severely dealt with.

3. The following acts of omission and/or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures:

   i. Ragging.

   ii. Furnishing false statement of any kind while filling the official forms or applications for award of scholarship etc.

   iii. Mutilation or unauthorized possession of library books.

   iv. Misuse of Internet/e-mail facilities or tempering/ hacking with servers anywhere in the places of residence/departments etc.

   v. Adoption of unfair means in the examinations.

   vi. Organizing or participating in any group activity in company with others inside or outside the campus without prior permission of the Director.

   vii. Leaving the campus without intimating the Warden of the hostel and without availing leave.

   viii. Displaying lack of courtesy and decorum; resorting to indecent behaviour anywhere inside or outside the campus.

   ix. Wilfully damaging or stealthily removing any property/belongings of the University, hostel or fellow students.

   x. Possession, consumption or distribution of alcoholic drinks or any kind of hallucinogenic drugs. Resorting to bad habits as smoking etc.

   xi. Creating/spreading unrest, resorting to noisy and unseemly behaviour, disturbing the studies of fellow students and disrupting the academic climate of the campus.

   xii. Inviting public personalities without the permission of the competent authority.

   Commensurate with the gravity of the offence, the punishment may be reprimanded, payment of fine and including expulsion from the Hostel, debarment from appearing for an examination(s), rustication for a specified period or even outright expulsion from the University.

4. For an offence committed (a) in the hostel, (b) in the University or a classroom and (c) elsewhere, the Warden, the Head of the Department and the Director, respectively, shall have the authority to reprimand or impose fine or take any other suitable measure. All cases involving punishment other than reprimand shall be reported to the Chairman of the Standing Disciplinary Committee.

5. (a) All major acts of indiscipline, which may have serious repercussion on the general body of students, and/or which may warrant a uniform and more formalized nature of investigation, shall be handled by the Standing Disciplinary Committee appointed by Vice-Chancellor. The Standing Disciplinary Committee consists of the following ex-officio and other members:

   i. Director / Administrative Officer - Chairman
   ii. Dean (Academics) - Member
   iii. Warden of the Hostel of which the student concerned is a boarder - Member
   iv. A student Representative nominated by the VC - Member
   v. A student representative nominated by the Director – Member
   vi. Chief Warden – Member
   vii. Head of the Department to which the reported student belongs - Member
   viii. Dean (Student Welfare) - Convener

In addition, the Chairman may invite any other person(s) to be associated with the proceedings of a particular case, if his/their participation is considered necessary in disposing of the matter.

(b) Recommendation of the committee, which will include the suggested punishment in cases of guilt proven, will be forwarded to the Vice-Chancellor for necessary action.

(c) For all major acts of indiscipline in hostels, necessary action will be taken against the students as per the rules and regulations of the hostels constituted by the University.

6. (a) Cases of adoption of unfair means in an examination shall be dealt with by the Committee on Prevention of Examination Malpractices consisting of the following members:

   i. Director / Administrative Officer - Chairman
   ii. Controller of Examinations - Member
   iii. Head of the Department to which the reported student belongs - Member
   iv. The Invigilator reporting the case - Member
   v. Chief Superintendent (Examinations) - Member
   vi. Dean (Academics) – Convener

In addition, the Chairman may invite any other person(s) to be associated with the proceedings of a particular case, if his/their participation is considered necessary in disposing of the matter.

(b) Recommendation of the committee, which include punishment recommended in cases of guilt proven, will be forwarded to the Vice-Chancellor for necessary action.

For any clarifications, pertaining to Academics and Examinations contact:

Office of the Dean Academics / Academic Section
Office of the Controller of Examination / Examination Section

Rajiv Gandhi University of Knowledge Technologies, Basar

Mechanical Engineering Syllabus (2019-20)

Course Structure for I B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester I						
Subject Code	Subject	SSN	L	T	P	C
18MA1101	Engineering Mathematics-I	BSC	3	1	0	4
19PH1103	Engineering Physics	BSC	3	1	0	4
19ME1101	Engineering Drawing & Graphics	ESC	1	0	4	3
19EE1101	Basic Electrical Engineering	ESC	3	1	0	4
18HS1101	English	HSMC	2	0	0	2
	Engineering Physics Lab	BSC	0	0	2	1
19EE1701	Basic Electrical Engineering Lab	ESC	0	0	2	1
18HS1701	English Lab	HSMC	0	0	2	1
19ME1701	Elements of Mechanical Engineering	PCC	0	0	2	1
	Total		**12**	**3**	**12**	**21**

Category: **Basic Science Course** Subject Code**: 18MA1101**

Engineering Mathematics – I

(Calculus & Linear Algebra)

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

Course outcomes: The student will be able to

1. Write the matrix representation of set of linear equations and to analyze the solution of the system of equations.
2. Find the Eigen values and Eigen vectors and reduce the quadratic form to canonical form using orthogonal transformations.
3. Analyze the nature of sequence and series.
4. Solve the applications on the mean value theorems and evaluate the improper integrals using Beta and Gamma functions.
5. Find the extreme values of functions of two variables with/without constraints.

UNIT-I

Matrix Theory: Types of Matrices, Symmetric, Hermitian, Skew-Symmetry, Skew-Hermitian, Orthogonal matrices, Unitary matrices; Elementary row and column operations on a matrix, Rank of a matrix by Echelon form and Normal form, Inverse of a Non-singular matrix by Gauss-Jordan method; Consistency and solutions of system of linear equations using elementary operations, Gauss elimination method; Gauss Seidel Iteration method.

UNIT-II

Eigen values and Eigen vectors: Linear Transformation and Orthogonal Transformation; Characteristic roots and vectors of a matrix; Diagonalization of a matrix; Cayley-Hamilton theorem(without proof) ; finding inverse and power of a matrix by Caylay-Hamilton Theorem; Quadratic forms and Nature of the Quadratic forms; Reduction of quadratic form to canonical form by Orthogonal transformation.

UNIT-III

Sequences & Series: Definition of a sequence, limit; Convergent, Divergent and Oscillatory sequences. Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test; Logarithmic test. Alternating series; Leibnitz test; Alternating Convergent series; Absolute and conditionally convergence.

UNIT-IV

Calculus: Mean value theorems: Roll's theorem, Lagrange's Mean value theorem, Cauchy's Mean value theorem; Taylor's and Macaurin's series with remainders, Expansions; Applications of definite integrals to evaluate surface area and volumes of revolutions of curves (Only in Cartesian coordinates): Definition of Improper Integrals and their convergence, Beta and Gamma functions and their applications.

UNIT-V

Multivariable Calculus (Partial Differentiation and applications): Definitions of Limits and continuity. Partial Differentiation; Euler's theorem; Total Derivative; Jacobian; Functional dependence and independence; Maxima and minima of functions of several variables (two and three variables) using Lagrange Multipliers.

TEXTBOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8th Edition
2. R.K.Jain and S.R.K.Iyengar Advanced Engineering Mathematics, Narosa Publications House, 2008
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

REFERENCES:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11^{th} Reprint, 2010.
3. N.P. bail and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Category: **Basic Science Course** Subject Code**: 19PH1103**

Engineering Physics

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

Course outcomes: The student will be able to

Unit I:

Motion of a Particle: Basic concepts on scalars and vectors, Vector resolution, Transformation of scalars and vectors under Rotation transformation, Extension to cylindrical and spherical coordinates, Newton's laws and its completeness in describing particle motion, Some applications of Newton's laws, Forces in Nature, Solving Newton's equations of motion in polar coordinates, Problems including constraints and friction.

Unit II:

Work and Energy: Work – Energy Theorem (in 1D and 3D), Work done by uniform force and central force, Potential energy function, Equipotential surfaces and meaning of gradient, curl of a force field, Energy equation and energy diagrams, Conservative and non-conservative forces, Problems.

Unit III:

Rigid body dynamics: Definition and motion of a rigid body in the plane, Rotation in the plane, Kinematics in a coordinate system rotating and translating in the plane, Angular momentum about a point of a rigid body in planar motion, Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion, Examples

Quantum Mechanics: Introduction to QM, Importance of wave function; Schrodinger Wave equation (SWE), Applications of SWE, Particle in a box.

Unit IV:

Electron Theory of Solids: Introduction to solids, Free electron Theory of metals, Fermi level, Density of states, Blochs Theorem for a particle in a periodic potential, Kronig Penny Model- origin of energy bands

Magnetic Properties of materials: Origin of magnetic moment, Magnetisation, Permeability and Susceptibility, Classification of magnetic materials, Ferromagnetism (Domain theory of ferromagnetism), Magnetic domains and hysteresis applications

Unit V:

Optics: Interference- Introduction and examples, Youngs, double slit experiment, Diffraction – Types, Single Slit, Double Slit, Diffraction Grating.

Crystallography: Introduction to Crystallography, Reciprocal spaces, Bravais Lattices, Miller Indices, Bragg's law, X ray Diffraction.

Text Books:

1. Engineering Mechanics, 2nd edition, Cambridge Publishers - MK Harbola
2. An Introduction to Mechanics, 2nd edition, Tata McGraw Hill Publishers — D Kleppner & R Kolenkow and NPTEL Lecture Notes by MK Harbola
3. Solid state Physics -- S.O.Pillai (NEW AGE International)
4. Engineering Physics --Dr.M.N.Avadhanulu,Dr.P.G.Kshirsagar (S.Chand)
5. Solid state physics and Electronics - R.K.Puri anV.K.Bubbar(S.Chand)

Category: **Engineering Science Course** Subject Code**: 19ME1101**

Engineering Drawing

Internals: 50 Marks **L - T - P - C**

Externals: 50 Marks **1 - 0 - 4 - 3**

Course Outcomes: The student will be able to

1. Use Engineering principles and techniques to understand and interpret engineering drawings.
2. Understand the concepts of AutoCAD.
3. Draw orthographic projections of lines, planes and solids using AutoCAD.
4. Use the techniques, skills and modern engineering tools necessary for engineering practices.

Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, types of lines and Dimensioning.

Over view of AutoCAD: Theory of CAD software (The Menu System, Tool Bars, Drawing area, Dialogue boxes, Shortcut Menu, the command lines, Select and erase objects, Introduction to layers etc.), Drawing simple figures- lines, planes, solids.

UNIT-I

Geometrical constructions: Construction of regular polygons.

Conic sections: Construction of Ellipse, Parabola, Hyperbola (General method only), Cycloid, Epicycloid, Hypocycloid and Involutes.

Scales: Construction of Plain, Diagonal and Vernier scales.

UNIT-II

Orthographic projections: Principles of Orthographic Projections

Projections of Points: Projections of Points placed in different quadrants

Projection of lines: lines parallel and inclined to both the planes (Determination of true lengths and true inclinations and traces)

UNIT-III

Projection of planes: Planes inclined to both the reference planes

Projection of Solids: Projection of solids whose axis is parallel to one of the reference planes and inclined to the other plane, axis inclined to both the planes

UNIT-IV

Projection of sectioned solids: Sectioning of simple solids like prism, pyramid, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

Development of surfaces: .Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

UNIT-V

Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views of planes and simple solids

Intersections: Basic concepts of perspective views.

Text/Reference Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., Engineering Drawing, Charotar Publishing House,2014
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
3. Shah, M.B. &Rana B.C, Engineering Drawing and Computer Graphics, Pearson Education,2008
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age publications
5. Agrawal B. & Agrawal C. M., Engineering Graphics, TMH Publication 2012,
6. Narayana, K.L. & P Kannaiah, Text book on Engineering Drawing, Scitech Publishers, 2008
7. (Corresponding set of) CAD Software Theory and User Manuals

COURSE ASSESSMENT METHODS		
Assessment Method	**Description**	**Weight**
Assignment & Continuous monitoring	Assignments & Evaluation of drawings	25%
Mid Term	Two Mid examinations will be conducted each of 25 Marks and best of the Two will be considered.	25%
End Term	Students will be evaluated based on the understanding of the principles, skills and practices of the course	50%

Category: **Engineering Science Course** Subject Code:**19EE1001**

Basic Electrical Engineering

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

Course Outcomes: At the end of this course, students will be able:

- To understand and analyse basic electric and magnetic
- To study the working principles of electrical machines and power converters.
- To introduce the components of low-voltage electrical installations.

Unit I : Circuits Analysis

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

AC Circuits: Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

UNIT II: Transformers

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

UNIT III: Electrical Machines

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

UNIT IV: Power Converters

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

UNIT V: Electrical Installations

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Text / References:

1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
4. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
5. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

Category: **HSM Course** Subject Code**: 18HS1101**

English

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

Course Outcomes: Students should be able to

1. Use English Language effectively in spoken and written forms.
2. Comprehend the given texts and respond appropriately.
3. Communicate confidently in various contexts and different cultures.
4. Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

UNIT –I

'The Raman Effect' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary Building: The Concept of Word Formation --The Use of Prefixes and Suffixes. **Grammar**: Identifying Common Errors in Writing with Reference to Articles and Prepositions. **Reading**: Reading and Its Importance- Techniques for Effective Reading. **Basic Writing Skills**: Sentence Structures -Use of Phrases and Clauses in Sentences Importance of Proper Punctuation- Techniques for writing precisely – Paragraph writing – Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs in Documents.

UNIT –II

'Ancient Architecture in India' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Synonyms and Antonyms. **Grammar:** Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement. **Reading:** Improving Comprehension Skills – Techniques for Good Comprehension. **Writing:** Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Job Application with Resume.

UNIT –III

'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English. **Grammar:** Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses. **Reading:** Sub-skills of Reading- Skimming and Scanning. **Writing:** Nature and Style of Sensible Writing- Defining- Describing Objects, Places and Events – Classifying- Providing Examples or Evidence

UNIT –IV

'What Should You Be Eating' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Standard Abbreviations in English. **Grammar:** Redundancies and Clichés in Oral and Written Communication. **Reading:** Comprehension- Intensive Reading and Extensive Reading. **Writing:** Writing Practices--Writing Introduction and Conclusion - Essay Writing-Précis Writing.

UNIT –V

'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Technical Vocabulary and their usage. **Grammar:** Common Errors in English. **Reading**: Reading Comprehension-Exercises for Practice. **Writing**: Technical Reports- Introduction – Characteristics of a Report – Categories of Reports Formats- Structure of Reports (Manuscript Format) - Types of Reports - Writing a Report.

Prescribed Textbook:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

Category: **Basic Science Course** Subject Code**: 19PH1601**

Engineering Physics Laboratory

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **0 - 0 - 2 - 1**

List of Experiments:

1. Coupled Pendulum
2. Spiral Spring Experiment
3. Fly Wheel
4. Dispersive Power
5. Photoelectric Effect
6. Magnetic Hysterisis Curve
7. Diffraction Grating
8. Newton's Rings
9. Torsional Pendulum
10. Energy Band Gap of a semiconductor
11. Magnetic field along an axis - Steward & Gee's Experiment
12. Experiment on Parallelogram law of vectors

Category: **Engineering Science Course** Subject Code**: 19EE1701**

Basic Electrical Engineering Laboratory

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **0 - 0 - 2 - 1**

Laboratory Outcomes: The students are expected to

- Get an exposure to common electrical components and their ratings.
- Make electrical connections by wires of appropriate ratings.
- Understand the usage of common electrical measuring instruments.
- Understand the basic characteristics of transformers and electrical machines.
- Get an exposure to the working of power electronic converters.

List of Laboratory Experiments/Demonstrations (any 10 of the following):

1. Introduction to Lab:

   (a) Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.

   (b) Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.

   (c) Demonstration of Components of LT switchgear.

2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.

3. Transformers: Observation of the no-load current waveform on an oscilloscope (non sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.

4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.

5. Torque Speed Characteristic of separately excited dc motor.

6. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections.

7. Torque-Slip Characteristic of an induction motor.

8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.

9. Power electronics (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and

10. Calibration of Energy Meter

11. 3-phase power measurement using two wattmeter method

12. Characteristic of the lamps (Tungsten, Fluorescent and Compact Fluorescent Lamps)

Category: **HSM Course** Subject Code**: 18HS1701**

English Laboratory

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **0 - 0 - 2 - 1**

Learning Outcomes: Students will be able to attain

- Better understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills

UNIT – I

Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening - Communication at Work Place- Spoken vs. Written language.

Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants -Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

UNIT – II

Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context- Features of Good Conversation – Non-verbal Communication.

Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context-Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

UNIT – III

Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI)- How to make Formal Presentations.
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation- Formal Presentations.

UNIT – IV

Understand: Listening for General Details-Public Speaking – Exposure to Structured Talks.
Practice: Listening Comprehension Tests- Making a Short Speech – Extempore

UNIT – V

Understand: Listening for Specific Details- Interview Skills.

Practice: Listening Comprehension Tests- Mock Interviews.

Suggested References:

1. Clarity English Success - Software
2. Connected Speech- Software
3. Issues in English 2- Software
4. http://www.clarityenglish.com/program/practicalwriting/
5. http://www.clarityenglish.com/program/roadtoielts/
6. http://www.clarityenglish.com/program/clearpronunciation1/
7. http://www.clarityenglish.com/program/resultsmanager/

Category: **Professional Course** Subject Code**: 19ME1701**

Elements of Mechanical Engineering

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **0 - 0 - 2 - 1**

UNIT I

Introduction: Components of a Four Wheeler Automobile – Chassis and Body – Power Unit –Power Transmission – Rear Wheel Drive, Front Wheel Drive, Four Wheel Drive – Types of Automobile Engines, Engine Construction

UNIT II

Emissions from Automobiles – Pollution Standards National and International – Multipoint Fuel Injection for SI Engines- Common Rail Diesel Injection, Electrical System: Charging Circuit, Generator, Current – Voltage Regulator – Starting System, Bendix Drive, Mechanism of Solenoid Switch

UNIT III

Transmission System: Clutches- Principle- Types, Fluid Fly Wheel – Gear Box- Types Torque Converter. Propeller Shaft – Hotch – Kiss Drive, Torque Tube Drive, Universal Joint, Differential, Rear Axles.

UNIT IV

Steering System: Steering Geometry – Camber, Castor, King Pin Rake, Combined Angle Toe-In, Center Point Steering. Types Of Steering Mechanism, Steering Gears – Types

UNIT V

Suspension System: Objects of Suspension Systems – Rigid Axle Suspension System, Torsion Bar, Shock Absorber, Independent Suspension System. Braking System: Mechanical Brake System, Hydraulic Brake System, Pneumatic and Vacuum Brake Systems.

Text Books:

1. Automotive Mechanics – Vol. 1 & Vol. 2, Kirpal Singh, Standard Publishers Distributors, 13th edition, 2013.

2. Automobile Engineering , William Crouse, TMH, 10th edition, 2006.

Reference Books: Automobile Engineering ,R.K.Rajput,Laxmi Pub, 1st edition, 2013.

Course Structure for I B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester II						
Subject Code	Subject	SSN	L	T	P	C
18MA1201	Engineering Mathematics-II	BSC	3	1	0	4
19CY1202	Engineering Chemistry	BSC	3	1	0	4
19ME1201	Engineering Mechanics	ESC	3	1	0	4
19CS1201	Programming for Problem Solving	ESC	3	0	0	3
19ME1202	Engineering Workshop	ESC	2	0	4	4
19ME1801	Engineering Chemistry Lab	BSC	0	0	2	1
19CS1801	Programming in C Lab	ESC	0	0	4	2
	Constitution of India		2	0	0	0
	Total		**16**	**3**	**10**	**22**

Category: **Basic Science Course** Subject Code**: 18MA1201**

Engineering Mathematics – II

(ODE& Complex Variables)

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

Course Outcomes:

At the end of the course student will be able to

- Solve first order linear differential equations and special non linear first order equations like Bernouli , Riccati & Clairaut's equations
- Compute double integrals over rectangles and type I and II" regions in the plane
- Explain the concept of a vector field and make sketches of simple vector fields in the plane.
- Explain concept of a conservative vector field, state and apply theorems that give necessary and sufficient conditions for when a vector field is conservative, and describe applications to physics.
- Recognize the statements of Stokes' Theorem and the Divergence Theorem and understand how they are generalizations of the Fundamental Theorem of Calculus.
- Able to solve the problems in diverse fields in engineering science using numerical methods.

UNIT-I

Ordinary Differential Equations of first order: Exact first order differential equation, finding integrating factors, linear differential equations, Bernoulli's , Riccati , Clairaut's differential equations, finding orthogonal trajectory of family of curves, Newton's Law of Cooling, Law of Natural growth or decay.

UNIT-II

Ordinary Differential Equations of higher order: Linear dependence and independence of functions, Wronskian of n- functions to determine Linear Independence and dependence of functions, Solutions of Second and higher order differential equations (homogeneous & non-homogeneous) with constant coefficients, Method of variation of parameters, Euler-Cauchy equation.

UNIT-III

Integral Calculus: Convergence of improper integrals, tests of convergence, Beta and Gamma functions - elementary properties, differentiation under integral sign, differentiation of integrals with variable limits - Leibnitz rule. Rectification, double and triple integrals, computations of surface and volumes, change of variables in double integrals - Jacobians of transformations, integrals dependent on parameters – applications.

UNIT-IV

Vector Differentiation: Vector point functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal line. Vector Identities. Scalar potential functions. Solenoidal and Irrotational vectors.

UNIT-V

Vector Integration: Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications. Numerical Methods: Introduction and motivation about numerical methods, True value, approximate value, error, error percentage, algebraic equations, transcendental equations, Newton-Raphson method, Bisection method.

Text Books:

1. Advanced Engineering Mathematics (3rd Edition) by R. K. Jain and S. R. K. Iyengar, Narosa Publishing House, New Delhi

References Books

1. Advanced Engineering Mathematics (8th Edition) by Erwin Kreyszig, Wiley-India.

2. Dr. M.D. Raisinghania,Ordinary andPartialdifferentialequations,S.CHAND,17th Edition,2014

Category: **Basic Science Course** Subject Code:**19CY1202**

Engineering Chemistry

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

UNIT - I: Electro Chemical Energy Systems (10 classes)

Types of electrodes: introduction, metal-metal ion electrodes, metal-insoluble salt-anion electrodes, calomel electrode, gas-ion electrodes, hydrogen and chlorine electrodes, oxidation-reduction electrodes, amalgam electrodes. Differences between primary cells and secondary cells. Construction, electro chemical reactions and applications of secondary cells – Ni-Cd battery, Lithium ion battery, Pb-acid storage battery, maintenance free lead acid battery. Construction, electro chemical reactions and applications of Fuel cells – H_2-O_2 fuel cell, Methanol-oxygen fuel cell, Phosphoric acid fuel cell.

UNIT - II: Corrosion and its Prevention (6 classes)

Dry and wet corrosion and their mechanisms. Pilling - Bedworth Rule. Types of Corrosion – galvanic corrosion, concentration cell corrosion, pitting corrosion and stress corrosion – Factors influencing the rate of corrosion – Temperature, pH and dissolved oxygen – Corrosion Prevention methods – Cathodic protection-Sacrificial Anodic method and Impressed current method – Metallic coatings –galvanization and tinning methods. Corrosion problems in boilers and heat exchangers and preventive measures.

UNIT - III: Water and its Treatment (8 classes)

Hardness of water – Calculation of hardness- Disadvantages of using hard water in Boilers – priming and foaming, sludge and scale formation – caustic embrittlement – Boiler corrosion. Treatment of boiler feed water – Zeolite process, Ion exchange process. Internal treatment – Calgon conditioning and Colloidal conditioning. Desalination of Brackish water by RO method.

UNIT - IV: Fuels (6 classes)

Definition and classification of fuels. Calorific value of a fuel – Characteristics of a good fuel. Coal – Types of Coal. Analysis of Coal – Proximate and Ultimate analysis. Bomb Calorimeter and Junker's gas Calorimeter. Problems on calculation of calorific value. Liquid fuels – Petroleum Extraction – Fractional distillation. Synthetic Petrol – Bergius process and Fisher Tropsch process. Problems on air requirement for combustion.

UNIT - V: Engineering materials (11 classes)

Polymers and Composites: Polymers – Definition of a polymer and polymerization – Degree of polymerization – Functionality – Types of polymerization – addition, condensation and co-polymerization with examples. Plastics – thermo plastics and thermo setting plastics. Compounding of plastics. Moulding techniques – Compression, Injection and Blow film moulding. Preparation, properties and applications of PVC, Polystyrene, Teflon and Bakelite. Composites – Definition of matrix and reinforcement. Fibre reinforced plastics – Glass fibre, Carbon fibre reinforced plastics. Preparation methods – hand layup method, matched metal die moulding method, Properties – applications

Lubricants: Definition and classification of lubricants. Functions of a good lubricant. Mechanism of lubrication. Experimental determination of properties of a liquid lubricant – Viscosity, Aniline point, Flash and Fire point, Pour and Cloud point. Additives to lubricants. Lubrication by nano films. Applications of lubricants.

Refer Books

1. **Engineering Chemistry, Jain & Jain**
2. **Engineering Chemistry, Shashi Chawla**
3. **Chemistry for Engineers, B. K. Ambasta**
4. **Engineering Chemistry, H. C. Srivastava**

Category: **Engineering Science Course** Subject Code**: 19ME1201**

Engineering Mechanics

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

Course Outcomes:

- Able to find out the various forces, moments and angles including resultants in various parts of wall crane, roof truss, pipes, etc
- Able to find out displacement, velocity and acceleration (and their angular counterparts) of a particle and forces acting on a particle.
- To find coefficient of friction between various materials on inclined plan and to understand its effect in screw jack, wedge etc
- Able to find out moment of inertia of simple as well as composite sections such cone, cylinder, hooks etc.

UNIT 1: Introduction to Engineering Mechanics, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy.

UNIT 2: Friction, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack;

UNIT 3: Basic Structural Analysis, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines.

UNIT 4: Centroid and Centre of Gravity, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications;

UNIT 5: Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

Text Books:

1. F. P. Beer and E. R. Johnson (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill

2. R. C. Hibbler, Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press, 2006

Reference Books

1. J. L. Meriam and L. G. Kraige (2013) Engineering Mechanics: Statics and Dynamics by Wiley Publication
2. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
3. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
4. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
5. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
6. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
7.Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

Category: **Engineering Science Course** Subject Code**:19CS1201**

Programming for Problem Solving

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT-I: Introduction to Programming & Arithmetic expressions and precedence, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). **Idea of Algorithm:** steps to solve logical and numerical problems. **Representation of Algorithm:** Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code. Arithmetic expressions and precedence.

UNIT-II: Conditional Branching , Loops & Arrays, Writing and evaluation of conditionals and consequent branching, Iteration and loops, Arrays (1-D, 2-D), Character arrays and Strings.

UNIT-III: Function & Basic Algorithms, Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT-IV: Recursion & Structure, Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort, Structures, Defining structures and Array of Structures

UNIT-V: Pointers & File handling, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation) File handling (only if time is available, otherwise should be done as part of the lab)

Suggested Text Books

(i) Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill

(ii) E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books

(i) Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Category: **Engineering Science Course** Subject Code**: 19ME1202**

Engineering Workshop

Internals (Theory) : 40 Marks **L - T - P - C**

Externals (Practical) : 60 Marks **2 - 0 - 4 - 4**

(i) THEORY

Course Objectives:

- To understand the basic manufacturing process of producing a component by casting, forming plastic molding, joining processes, machining of a component either by conventional or by unconventional processes.
- To understand the advanced manufacturing process of additive manufacturing process.

Course Outcome:

- Students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Module – 1: ***Metal Casting*****:** Introduction, Tools, Types of Patterns, Pattern Materials, Types of casting – Sand, Die and other casting processes and Applications

Module – 2: ***Metal Forming*****:** Introduction, Classification, Types of Bulk and sheet metal forming and Applications.

Module – 3: ***Powder Metallurgy*****:** Introduction, Powder production methods, Compaction, Sintering, Secondary operations and Applications.

Module – 4: ***Joining:*** Types of Joining, Introduction to Welding, Brazing and soldering, Arc, Solid state welding processes.

Module – 5: ***Conventional Machining processes*****:** Introduction to machining operations; Lathe operations, Drilling, Milling and Grinding.

Module – 6: ***Unconventional Machining processes***.

Module – 7: ***CNC Machining and Additive manufacturing***

Text Books:

(i) Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

(ii) Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

Reference Books

(i)Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.

(ii) Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

(iii) Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

(ii) PRACTICALS

Course Outcomes: Upon completion of this laboratory course

- Students will be able to fabricate components with their own hands.

List of Experiments:

1. **Fitting –** Step and V Fit
2. **Carpentry** – Half lap joint and Dove tail joint
3. **House Wiring** – Series, Parallel, Staircase and Godown wiring
4. **Tin Smithy** – Tray and Cylinder
5. **Welding** – Bead formation, Butt and Lap joint welding
6. **Foundry** – Mold preparation with Single piece and Split piece pattern
7. **Machining** – Plain turning, Facing, Step and Taper turning
8. **Plastic molding** – Demo
9. **WIRE EDM, CNC, 3D Printer** - Demo

COURSE ASSESSMENT		
Assessment Method	**Description**	**Weight**
Mid Term	3 mid examinations will be conducted and best of 2 will be considered.	30%
Assignment	Seminar / Test / Practical	10%
End Sem Practical	Students will be evaluated based on the understanding of the principles and performance skills and practices of the course	60%

Category: **Basic Science Course** Subject Code**: 19ME1801**

Fuels and Lubricants Laboratory

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **0 - 0 - 2 - 1**

List of Experiments:

1. Determination of viscosity of given lubricating oil by using redwood viscometer.
2. Determination of flash and fire point of the given Lubricating oil
3. Determination of pour and cloud point of the given lubricating oil.
4. Determination of calorific value of fuel by bomb calorimeter.
5. Determination of calorific value of gaseous fuel by Junker's gas calorimeter.
6. Determination of pH of given water sample.
7. Determination of rate of corrosion of carbon steel metal in acid medium in the absence and presence of Thiourea inhibitor by gravimetric method.

Category: **Engineering Science Course** Subject Code**: CS1601**

Programming for Problem Solving Laboratory

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **0 - 0 - 4 - 2**

List of Experiments:

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems e.g., sum of series
5. 1D Array manipulation
6. Matrix problems, String operations
7. Simple functions
8. Recursive functions
9. Pointers and structures
10. File operations

Course Structure for II B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester III						
Subject Code	Subject	SSN	L	T	P	C
19MA2106	Engineering Mathematics-III	BSC	3	1	0	4
19EC2104	Basic Electronics Engineering	ESC	3	0	0	3
19ME2101	Strength of Materials	PCC	3	1	0	4
19ME2102	Thermodynamics	PCC	3	1	0	4
19ME2103	Materials Engineering	PCC	3	0	0	3
19ME2701	Strength of Materials Lab	PCC	0	0	2	1
19ME2702	Materials Engineering Lab	PCC	0	0	2	1
19HS2101	Essence of Indian Traditional Knowledge		2	0	0	0
	Total		**17**	**3**	**4**	**20**

Category: **Basic Science Course** Subject Code**: 19MA2106**

Engineering Mathematics – III

(PDE, Probability)

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

Course Outcomes:

Upon completion of this course, students will be able to solve field problems in engineering involving PDEs. They can also formulate and solve problems involving random variables and apply statistical methods for analysing experimental data.

Unit-I:

Introduction to PDE, formation of PDE, order, degree of PDE.Linear, semi-linear, quasi-linear, non-linear PDE of first order. Linear PDE of order one, Lagrange's method of solution and geometrical interpretation, non-linear PDE of order one, classification of integrals, compatibility condition, Charpit's method standard formulas.

Unit-II:

Solving higher order PDE

Homogeneous linear PDE of higher order with constant coefficients, non-homogeneous linear PDE with constant coefficients, non-linear second order PDE, Monge's method.

Unit-III:

Applications of PDE

Classification of second order PDE, Wave equation, Heat equation, and Laplace's equation, Method of separation of variables to solve PDE,integral transforms method to solve second order PDE.

UNIT-IV:

Probability

Random Variables and Probability Distributions: Concept of a Random Variable, Discrete Probability Distributions, Continuous Probability Distributions, Statistical Independence, Definition of Cumulative Distribution function and its properties for Discrete and Continuous distributions.

Mathematical Expectation: Mean of a Random Variable, Variance and Covariance of Random Variables, Means and Variances of Linear Combinations of Random Variables, Chebyshev's Theorem.

Discrete Distributions:Binomial, Poisson, Negative-Binomialdistributions, Geometric Distribution.

UNIT-V:

Continuous Distributions: Uniform Distribution, Normal Distribution, Exponential Distribution.

Fundamental Sampling Distributions: Random Sampling, Some Important Statistics, Sampling Distributions, Sampling Distribution of Means and the Central Limit Theorem, Sampling Distribution of S2, t –Distribution, F-Distribution.

Textbooks/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
3. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003.
4. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
5. Advanced Engineering Mathematics (3rd Edition) by R. K. Jain and S. R. K. Iyengar, Narosa Publishing House, New Delhi
6. Dr. M.D. Raisinghania,Ordinary andPartialdifferentialequations,S.CHAND,17th Edition,2014

Category: **Engineering Science Course** Subject Code**: 19EC2104**

Basic Electronics Engineering

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 0 - 0 - 3**

Course Outcomes:

1. Understand the basics of PN junction diodes, transistors and their applications.
2. Understand BJT and Design and analyze BJT amplifiers.
3. Understand MOSFET and its application.
4. Learn how to bias the transistors for their application as amplifiers.
5. Ability to design simple electronic circuits to meet a practical requirement.

Unit-I: Introduction to Electronics

Introduction to Electronics and Electronic systems, Theory of Semiconductors, pn Junction Diode, Rectifiers: Half Wave Rectifier, Full Wave Rectifier, LEDs, Photo Diodes, Silicon Controlled Rectifier.

Unit-2: Transistors

Bipolar Junction Transistor, Transistor in CB and CE Configurations, Junction Field Effect Transistor, JFET Characteristics, MOSFET, Biasing of Transistors, Biasing of JFET.

Unit-3: Amplifiers and Transistor models

Introduction to Amplifiers, Transistor Re Model, Transistor h parameter model, BJT Small Signal Analysis, JFET Signal Analysis, feedback Amplifiers, Phase Shift Oscillators, Wein Bridge Oscillators

Unit-4: Operational Amplifiers

Differential Amplifiers, operational amplifiers, applications of operational amplifiers:, Constant-Gain Multiplier , Voltage Summing , Voltage Buffer , Controller Sources, Instrumentation Circuits ,Active Filters .

Unit-5: Digital Electronics:

Logic gates: basic gates, universal gates, realization of logic gates.

TEXT BOOKS:

1. Electronic Devices and Circuit Theory – Robert L.Boylestad, Louis Nashelsky, 9th edition, 2008 PE

2. Electronic Devices and Circuits- David A. Bell- 5th Edition, Oxford University Press.

REFERENCE BOOKS:

1. Electronic Circuits Analysis and Design – Donald A Neamen, Third Edition, Tata McGraw-Hill, 2007.

2. Introductory Electronic Devices and Circuits- Robert T. Paynter, 7th edition, 2009, PEI.

3. Microelectric circuits- sedra/ Smith- 5th edition, 2009, Oxford University Press.

Category: **Professional Core Course** Subject Code**: 19ME2101**

Strength of Materials

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 1 - 0 - 4**

COURSE OUTCOMES:

- Able to understand the basic concept of stress and strains and deformation for basic geometries subjected to axial loading and thermal effect.
- Able to find the maximum shear force and maximum bending moment by drawing the shear force and bending moment diagrams for different types of beams with different lateral loading condition.
- Able to find the strength of the various cross sectional beams such as rectangular, hollow circular, circular T, I sections etc.
- Able to calculate the deflections of the beam using different methods under different boundary and loading conditions
- Able to find the shear strength of the solid and hollow shafts which are subjected to torsional loading in power transmission.
- Able to learn about the strain energy concept.

Unit – I

Simple stresses and strains: Types of stresses and strains. Hooks's Law, Stress- Strain curve for ductile materials, moduli of elasticity.Poisson's ratio, linear strain, volumetric strain, relations between elastic constants. Bars of varying sections, bars of uniform strength, compound bars and temperature stresses, change in length.
Complex Stresses: Stresses on oblique planes, principle stresses and principle planes. Mohr circle of stress.

Unit-II

Shear Force and Bending Moment: Relation between intensity of loading. Shear force and bending moment, shear force and bending moment diagrams for cantilever and simply supported beams for point loads, uniformly distributed loads, uniformly varying loads and couples.

Unit-III

Theory of simple bending: Assumptions derivation of basic equation: $M/I = f/y = E/R$, Modulus of section, Moment of resistance, determination of flexural stresses.

Direct and Bending Stresses: Basic concepts, core of sections for rectangular, solid and hollow circular and I sections.

Unit-IV

Distribution of shear stress: Equation of shear stress, distribution across rectangular, circular, T and I sections.
Deflections: Deflections of cantilever and simply supported beams for point loads and uniformly distributed loads by double integration and Macaualay's method.
Strain Energy: Strain energy in bars due to gradually applied loads, sudden loads, impact loads and shock loads.

Unit-V

Torsion-Theory of pure torsion- derivation of basic equation **$T/J = y/R = G\Theta/L$** and hollow circular shafts, power transmission, combined bending and torsion.
Columns – Euler column theory, Expression for crippling load, Limitations of Euler's Formula

Suggested Readings:

1. A Text book of Strength of materials by R.K. Bansal, Laxmi Publications (P) Ltd., 6th Edition, 2015

2. R.K. Rajput, Strenght of Materials, S. Chand & Co., 2003.

3. Mechanics of materials by James M. Gere.,Thomson Brooks/cole., 5th Edition,2004

4. B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Publishers, Delhi, 2000.

5. R. Subramanian Strength Of Materials 3/E , Published by Oxford University Press.

6. S. Ramamrutham, Strength of Materials, Dhanpat Rai & Sons, 1993.

Category: **Professional Core Course** Subject Code**: 19ME2102**

Thermodynamics

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

COURSE OUTCOMES:

- Able to understand the thermodynamic properties, process, cycle, equilibrium and concepts of systems, surroundings and universe andthe energy transfer in the form of work and heat.
- The students will be able to apply energy balance to systemsand control volumes, in situations involving heat and work interactions.
- Able to understand the Carnot cycle and major difference in the working principles of heat engine, heat pump and refrigerator to calculate the maximum efficiency / COP of the cycle. Also student will learn the irreversibity processes, entropy change and maximum available energyby a process.
- Able to understand the concept of phase change of a pure substance and graphical representation of a pure substance on p-v, p-T, T-v, h-s and T-s diagrams, the usage of Steam tables and Mollier diagrams to solve problems. And the students will also learn to derive the thermodynamics relations involving entropy, enthalpy and internal energy.
- The students will be able to understand the working principles of air standard cycles such as Otto, Diesel and dual cycles.

UNIT I

Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work - Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work. Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; Examples of heat/work interaction in systems.

UNIT II

First Law for Cyclic & Non-cyclic processes; Concept of total energy (E), Various modes of energy, Internal energy and Enthalpy. First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; Examples of unsteady processes. First law applications for system and control volume.

UNIT III

Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.

Clausius inequality; Definition of entropy (S), Evaluation of S for ideal gases undergoing various processes; - Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.

UNIT IV

Thermodynamic properties relations involving Entropy, Enthalpy and Internal Energy.TdS equations – difference in heat capacities and ratio of heat capacities. Maxwell's relations, Joule-Kelvin Expansion.Clausius-Clayperon equation.

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam Tables, Saturation tables; Superheated tables; Identification of states &determination of properties. Mollier's chart.

UNIT V

Air Standard Cycles - nomenclature for reciprocating piston cylinder engine. Thermodynamics analysis of Air standard cyclessuch as Otto, Diesel and Dual cycles. Comparison of Otto, Diesel and dual cycles based on same compression ratio or same maximum pressure and temperature. Atkinson cycle and Lenoir cycle.

Text Books:

1. Nag P.K, "*Engineering Thermodynamics*': Tata McGraw Hill Publishing, 8th Edn, 3rd Reprint 2010.

2.Yunus A Cengel and Michael A Boles, "*Thermodynamics-An Engineering Approach*", Tata Mc Graw Hill Publishing Company Ltd. ,6thEdn., Fifth Reprint, 2009.

3. Nag P.K, "*Basic & Applied Thermodynamics*': Tata McGraw Hill Publishing, 8th Reprint 2006.

4. Richard E.Sonntag, C.Borgnakke, G.J Van Wylen, "Fundamentals of Thermodynamics': John Wiley & Sons, 7th Edn., 2009.

5. Rajput R K, " *Engineering Thermodynamics*" Laxmi Publications, 4th Edition, 2010

REFERENCES :

1. Fundamentals of Thermodynamics – Sonntag, Borgnakke and van wylen, John Wiley & sons (ASIA) Pte Ltd.

2. Thermodynamics – An Engineering Approach – YunusCengel& Boles, TMH

3. Thermodynamics – J.P.Holman, McGrawHill

4. An introduction to Thermodynamics, YVC Rao, New Age

5. Engineering Thermodynamics – Jones & Dugan

Category: **Professional Core Course** Subject Code**: 19ME2103**

Materials Engineering

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

COURSE OUTCOMES:

- Students will get knowledge on bonds, crystallization of metals and effect of grain boundaries on the properties
- Students will be able to carry out the different mechanical testing methods to determine the mechanical properties of the materials.
- Students will be able to construct the equilibrium diagrams by experimental methods and knowing all types of equilibrium diagrams
- Students will be able to learn the structure and properties of all cast irons, steels and Non-ferrous metal alloys

Unit I:

Introduction: Classification of materials, properties of materials, advanced material, future and modern materials. Atomic structure, inter atomic bonding and structure of crystalline solids, Influence on properties of materials. Crystal structures, crystallography, planes and directions.

Imperfections in solids: Solidification process and Imperfections point, line, surface and volume defects, characteristics of dislocations, interactions between dislocations.

Unit II:

Deformation behaviors of materials: Elastic deformation, plastic deformation, and time dependent deformation processes, failure of materials, Fracture, fatigue and creep concepts and their significance.

Mechanical Properties of material and testing: Stress vs Strain graph, Tension test, Compression Test, Brinells, Vickers, Rockwell hardness test and micro hardness testing. Impact testing, creep test, fatigue test and fracture of materials and testing.

Methods of Melting: Crucible melting and cupola operation, steel making processes.

Unit III:

Phase Diagrams: Gibbs phase rule, cooling curves for pure metals and alloy, construction of phase diagrams, Equilibrium of phase diagrams (isomorphous, eutectic, partial eutectic and layered system), lever and tie line rule, phase transformation, iron-iron carbide phase diagram, different phases and applications in iron carbon system.

Unit IV:

Heat treatment and TTT curves: Transformation rate effects and TTT and CCT diagrams, microstructure and property changes in iron-carbon diagrams. Heat treatment of steel, Annealing, Normalizing, Hardening, Tempering, Austempering and Martempering of steels. Surface hardening of steels. Carburizing, Nitriding, Cyaniding, Flame and induction hardening methods.

Unit V:

Cast Irons and Steels: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, tool and die steels.

TEXT BOOKS :

1. Introduction to Physical Metallurgy, Sidney H. Avener.

2. Essential of Materials Science and Engineering, Donald R.Askeland, Thomson.

REFERENCES :

1. Material Science and Metallurgy, Kodgire.

2. Science of Engineering Materials, Agarwal

3. Materials Science and Engineering, William and collister.

4. Elements of Material science, V. Rahghavan

5. Engineering Materials and Their Applications – R. A Flinn and P K Trojan, Jaico Books.

6. Engineering materials and metallurgy, R.K.Rajput, S.Chand.

Category: **Professional Core Course** Subject Code**: 19ME2701**

Strength of Materials Laboratory

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **0 - 0 - 2 - 1**

Course Outcomes: After the completion of the course student should be able to

- Clearly understands the concepts of deciding the shape or type of specimen for assessing different strengths against various straining actions.
- Design the specimens for assessing a particular property of the material with the available machines.
- Decide the suitability of the material to the particular situation e.g., dynamic loads, vibrations, impacts, fatigue, etc.,
- Design the experiments making use of various techniques of load measuring or deformation measuring instruments.

List of the Experiments

1. Uni-axial Tension test on a specimen of Ductile Material.
2. Bending test on Cantilever beam of steel or timber.
3. Bending test on simply supported beam.
4. Torsion test on a specimen of ductile material
5. Brinell Hardness test
6. Rockwell Hardness test
7. Compression tests on helical spring.
8. Compression test
9. Impact test- Izod Tests.
10. Impact test - Charpy Impact
11. Direct Shear test.
12. Verification of Maxwell's Reciprocal theorem on beams.
13. Simple bending of sheet (Air Bending)

Category: **Professional Core Course** Subject Code**: 19ME2702**

Materials Engineering Laboratory

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **0 - 0 - 2 - 1**

Objectives:

- To familiarize the procedure for specimen preparation
- To prepare different metal specimen for identification
- To study the microstructure of metals and alloys
- To understand the heat treatment procedures
- To study the microstructure after heat treatment

List of Experiments:

Study of: Metallurgical Microscope, Iron-Iron Carbide diagram, Procedure for specimen preparation

1. Metallographic Study of Low / Medium carbon steel
2. Metallographic Study of Eutectoid steel
3. Metallographic Study of Hyper Eutectoid steel
4. Metallographic Study of Nodular cast iron
5. Metallographic Study of Grey cast iron
6. Metallographic Study of White cast iron
7. Metallographic Study of Brass and Bronze
8. Metallographic Study of microstructure after hardening, normalizing and annealing of steel specimen.
9. Quantitative analysis of Grain Size, ASTM Grain number
10. Quantitative analysis of Volume fraction

Course Structure for II B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester IV						
Subject Code	Subject	SSN	L	T	P	C
19ME2201	Fluid Mechanics and Hydraulic Machines	PCC	3	1	0	4
19ME2202	Instrumentation and Control Systems	PCC	3	1	0	4
19ME2203	Manufacturing Process	PCC	3	1	0	4
19ME2204	Kinematics of Machinery	PCC	3	0	0	3
19ME2205	Metrology and Machine Tools	PCC	3	0	0	3
19ME2801	Fluid Mechanics & Hydraulic Machinery Lab	PCC	0	0	2	1
19ME2802	Metrology and Instrumentation Lab	PCC	0	0	2	1
19ME2803	Manufacturing Process Lab	PCC	0	0	2	1
	Total		**17**	**3**	**6**	**21**

Category: **Professional Core Course** Subject Code**: 19ME2201**

Fluid Mechanics and Hydraulic Machines

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 1 - 0 - 4**

COURSE OUTCOMES:

- Able to know the fluid properties and their engineering significance.
- Able to determine the pressure at a point and identify the variation of pressure in a fluid.
- Able to understand the basic concepts of fluid motion.
- Able to analyze different flow characteristics of laminar and turbulent flows
- Able to understand the boundary layer and its significance along with the various concepts of boundary layer like its growth, thickness and separation.
- Able to understand the concept of flow around the submerged objects
- Able to know the characteristics of compressible fluids flow and Mach number and its significance

UNIT-I

Properties of Fluids: Introduction, definition of fluid, Units of measurement, Fluid Properties- mass density, specific weight, specific gravity, Viscosity, Newton's law of viscosity – Newtonian and non Newtonian fluids. Classification of fluids- Ideal and real.

Fluid Statics: Fluid pressure at a point, variation of Pressure in a fluid, measurement of Pressure-simple manometers, differential manometers.

Fluid Kinematics: Fundamentals of fluid flow –types of fluid flow, description of flow pattern, basic principles of fluid flow, continuity equation, acceleration of a fluid particles.

UNIT-II

Fluid dynamics: Introduction, forces acting on a fluid in motion, Euler's equation of motion, Bernoulli's equation, application of Bernoulli's equation – venturimeter, pilot tube. Impulse momentum equation, application of impulse momentum equation – Forces on a pipe bend.

Flow through pipes: Introduction, two types of flow – laminar and turbulent – Reynold's experiment. Laws of fluid friction, Darcy- Weisbach equation. Steady laminar flow- circular pipes – Hagen-Poiscuille's law. Hydrodynamically smooth and rough boundaries and it's criteria and resistance to flow of fluid in smooth and rough boundaries – variation of friction factor.

UNIT-III

Boundary layer theory: Introduction, thickness of boundary layer, boundary layer along a flat thin plate and its characteristics. Laminar and turbulent boundary layer, laminar sub layer, separation of boundary layer and its control.

Fluid flow around submerged objects: Drag and lift – Introduction, types of drag, drag on a flat plate. Development of lift on immersed bodies – lift of an airfoil

UNIT-IV

Flow of compressible fluids: Introduction, concepts of compressible flow, continuity and energy equation, propagation of elastic waves due to compression of fluid, velocity of sound, Mach number and its significance, propagation of elastic waves due to disturbance of fluid stagnation properties, area velocity relationship for compressible flows.

UNIT-V

Pumps : Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps

Turbines : Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities

Suggested Reading:

1. K.Subramanya,Theory and Applications of fluid Mechanics, Tata McGraw-Hill Publishing Company Ltd., New Delhi,1993.

2. Vijay Gupta and Santhosh K. Gupta, Fluid Mechanics and its applications, wiley Eastern Ltd.,New Delhi,1984.

3. K.L.Kumar, Engineering Fluid Mechanics, Eurasia Publishing House PVT Ltd, New delhi,2009.

4. P.N.MOdi,and S.M.Seth., Hydralics and Fluid Mechanics, Standard Book House, 1995.

5. Fluid Mechanics & Hydraulic Machines, S.C. Gupta, Pearson Publishers.

Category: **Professional Core Course** Subject Code**: 19ME2202**

Instrumentation and Control Systems

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 1 - 0 - 4**

Course Outcomes:

1 elucidate the construction and working of various industrial devices used to measure displacement, pressure, sound, flow, temperature, level, vibration.

2. ability to analyze, formulate and select suitable sensor for the given industrial applications.

3. able to describe the type of System, dynamics of physical systems, to represent system by transfer function

4. demonstrate the working and application of different type of actuators and control valves

5. able to apply techniques for controlling devices automatically.

UNIT I

Mechanical measurement systems: Performance – accuracy, range, resolution, error sources

Sensors for common mechanical measurements- position, linear and rotational speed, pressure, force, flow, liquid level and temperature.

UNIT II

Signal conditioning: Signal level and bias changes, linearization, conversion, filtering and impedance matching, concept of loading, Passive circuits, Operational Amplifiers circuits in instrumentation, Converters (comparators, ADC, DAC)

UNIT III

Control systems: Basic elements of open/closed loop, design of block diagram; control method – P, PI, PID, when to choose what, tuning of controllers;

UNIT IV

Correction elements and PLC systems: Pneumatic, hydraulic, electric systems, Basic elements involved with PLC systems.

UNIT V:

System models: Models for physical systems in terms of simple building block, Transfer function – block diagram simplification techniques, and System response-System parameters, Concepts in Stability of systems. Frequency response- Construction of Bode plot, Deduce transfer function from practically obtained Bode plot. Nyquist diagrams- Draw and interpret.

TEXT BOOKS:

1.*Instrumentation and control systems*, W. Bolton, 1st edition, Newnes, 2004.

2. *Mechanical Measurements*, Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard V, 6th Edition, Pearson Education India, 2007

3. *Measurement systems Application and design,* Ernest O. Doebelin, 4th edition, McGraw hill Publishing company., 1990.

REFERENCES:

1. *Control Systems Engineering*, Nise, 6th edition, John Wiley & Sons, Inc., 2011

2. *Process/Industrial Instruments and Controls Handbook,* Gregory K. McMillan 5th Edition, McGraw-Hill: New York, 1999.

Category: **Professional Core Course** Subject Code**: 19ME2203**

Manufacturing Process

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 1 - 0 - 4**

COURSE OUTCOMES:

- Able to understand the elements of casting, construction of patterns and gating systems, moulds, methods of moulding, moulding machines and solidification of castings of various metals.
- Able to understand the different types of welding processes, welds and weld joints, their characteristics, cutting of ferrous and non-ferrous metals by various methods.
- Able to understand the basic concept on one, two and three dimensional stress analysis, theory of plasticity; strain hardening, hot and cold working process.
- Able to understand the principles of Extrusion, rolling, forging processes, wire drawing and sheet metal processes, their applications and defects.
- Able to understand the basic concepts of the philosophy of metal cutting and the mechanism of chip formation. Student will understand the effect of various cutting parameters on cutting forces
- Able to know the various concepts about tool wear, tool life, cutting fluid etc.,

UNIT – I

Casting: Introduction, Pattern allowances and their Construction. Principles of Gating, Gating ratio and design of Gating systems, time of filling the cavity. Moulds: definition, mould materials, types of moulds, moulding methods, moulding machines, tests. Solidification of casting – Concept – Solidification of pure metal and alloys, short & long freezing range alloys.

Risers – Types, function and design, casting design considerations, Design of feeding systems i.e., sprue, runner, gate and riser, moulding flasks. Problems, Casting inspection and defects

UNIT – II

Welding : Classification of welding process, power characteristics, types of welds and welded joints and their characteristics, design of welded joints, Thermit welding and Plasma (Air and water) welding. Defects, causes and remedies. Problems

UNIT – III

Forming: Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth, Comparison of properties of Cold and Hot worked parts, **Rolling:** Theory of rolling, Mechanics of rolling. **Extrusion:** Basic extrusion process and its characteristics, Analysis of wire drawing and extrusion. **Forging:** Principles of forging – Tools and dies, Analysis of Forging, **Deep Drawing:** Analysis of deep drawing, tests for measuring of formability.

UNIT-IV

Mechanics of Machining: Single point cutting tool-types of reference systems–ASA,ORS and NRS systems and their Inter-relationships. Mechanism of chip formation, shear plane model. types of chips, effect of cutting parameters Forces in chip formation-Cutting force analysis- Ernst and Merchant analysis-theory of Lee and Shaffer. Effect of various cutting parameters on cutting forces, Theory of strain and strain rate in metal cutting and Energy considerations.

UNIT-V

Tool Wear Life and Machinability: Different causes-various forms of tool wear-measurement of tool wear. Tool life. Machinability-criterion for machinability-influence of variables affecting machinability. Measurement of Cutting Forces and Temperatures Tool Materials: Various tool materials, their properties and general guidelines for selection. Cutting Fluids: Functions, properties, types and selection. Economics of Metal Cutting: Various types of costs and their estimation. Determination of cutting speed for maximum production rate and minimum cost criteria.

TEXT BOOKS:

1. Manufacturing Technology, P.N. Rao,TMH
2. Manufacturing Technology, Kalpak Jain, Pearson education

REFERENCES:

1. Production Technology, R.K. Jain
2. Process and materials of manufacturing –Lindberg, PE
3. Principles of Metal Castings, Rosenthal.
4. Welding Process, Parmar
5. Manufacturing Technology, R.K. Rajput, Laxmi Pub
6. Rapid Prototyping Principles and Applications, Rafiq Noorani, Wiely Pub.
7. Unconventional Machining Processes, V.K. Jain, Allied Pub.
8. Production Technology, K.L Narayana, I.K. International Pub

Category: **Professional Core Course** Subject Code**: 19ME2204**

Kinematics of Machinery

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

Course Outcome

- Upon successful completion of this course, the student will be able to
- Calculate the degrees of freedom for a given mechanism, perform number synthesis
- Perform velocity and acceleration analysis of simple mechanisms, determine Power transmitted in belt drives
- Generate cam profile for a specified motion of follower.
- Determine number of teeth and basic dimensions for a gear pair avoiding interference
- Determine number of teeth for gears of a gear train with a predefined speed ratio.

UNIT I

Terminology: Definitions of link, pair, chain and mechanism, degrees of freedom, Isomers,Inversion, Type, Number and Dimensional Synthesis

Basic Laws: Kutzbach and Grubbler's criterion. Grashof's Law

Simple mechanisms: four bar mechanism, single and double slider crank mechanisms. Ackerman and Davis steering gear mechanism, Hooke's Joint,Geneva mechanism.

Straight line mechanisms: Pantograph Peaucellier, Hart, Scott-Russel, Watt and Tchebicheff mechanisms

UNIT II

Velocity and acceleration analysis of planar mechanisms: Velocities in mechanisms by instantaneous center method, Instantaneous Centre, Space Centrode and Body Centrode, Kennedy Theorem. velocity and acceleration of mechanisms by using relative velocity method including Coriolis component of acceleration, Klien's construction

UNIT III

Belt, Rope and chain drives: Types of belt drives, Action of Belts on pulleys, Velocity ratio, Slip, material for belts & ropes, crowning of pulleys, Types of pulleys, Law of belting, Length of belt in case of open belt drive and crossed-belt drive, Ratio of friction tensions, power transmitted, Centrifugal effect on belts, Maximum power transmitted by a belt, initial tension, Creep, Types of Chains, chain length, Angular speed ratio**.**

UNIT IV

Cam and follower: Types of Cams and followers, motion of the follower, follower displacement diagram, Cam profile for specified follower motion and Cams with specified contours.

UNIT V

Gears: Theory of Gearing, Terminology and Definitions, Law of Gearing, Tooth profiles, Path of contact and Arc of contact. Interference, methods of avoiding interference. Contact Ratio. Introduction to Helical, Bevel and worm gears.

Gear Trains: Simple, Compound, Reverted and Epicyclic gear trains. Differential of an Automobile.

TEXT BOOKS:

1. *Theory of Machines*, S.S Rattan, 4th Edition, 2015, Tata Mc-Graw Hill.
2. *Theory of Mechanisms and machines*, Amitabha Ghosh & A. K. Malik,3rd Edition, 2008, East West Press private limited.
3. *Mechanism and machine theory*, Ashok G. Ambekar, 1st Edition, 2007, Prentice Hall India

REFERENCES:

1. *Theory of machines*, R.S. Khurmi& J. K. Gupta,14thRevised edition, S Chand,2005
2. *Theory of Machines*, Thomas Bevan, 3rd Edition, 2005, CBS Publishers and Distributors
3. *Kinematics and Dynamics of machinery,* Robert. Norton, 2009, Tata Mc- Grawhill
4. *Theory of Machines and Mechanisms*, Shigley J.E and Uicker J.J, 3rd Edition, 2009, Oxford university press
5. *Mechanisms and Machine Theory*, J.S. Rao and R.V. Dukkipati, 1992, Wiley Eastern Limited

Category: **Professional Core Course** Subject Code**: 19ME2205**

Metrology and Machine Tools

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 0 - 0 - 3**

COURSE OUTCOMES:

- Able to understand the limits, fits and tolerance. Indian standard system, international standard organization system
- Able to know the principles of working of the most commonly used instruments for measuring linear and angular distances
- Able to study the different types of comparators, optical measuring instruments, flatness measurement methods and measuring methods of surface roughness
- Able to understand the basic concepts of the philosophy of metal cutting and the mechanism of chip formation.
- Able to understand about machine tools such as Lathe, Drilling, Milling etc.,
- Able to calculate the machining time
- Able to understand the principles of design of Jigs and fixtures and their uses

UNIT-I

Introduction, Accuracy and precision, Limits, Fits and Tolerances, ISO system. Types of interchangeability. Slip gauges and end bars. Height gauges, Abbe's rule, Types of micrometers. Tomlinson gauges, sine bar, autocollimator, calibration of precision polygons and circular scales. Dial indicator, Sigma mechanical comparator. Free flow and back pressure type Pneumatic comparators. Contact & non-contact tooling, Applications of single and multijet gauge heads; computation and match gauging.

UNIT-II

Taylor's principles for plain limit gauges. Usage and limitations of Ring and Snap gauges. Indicating type limit gauges. Position and receiver gauges, principles of thread gauging. Gauge materials and steps in gauge manufacture. Surface roughness characteristics and its measurement. Tool maker's microscope, Floating carriage diameter measuring machine and coordinate measuring machine. Measurement of straightness and flatness using autocollimator. Roundness measurement with intrinsic datum (V-block, Bench centers) and extrinsic datum (TALYROND).

UNIT – III

Introduction to machine tools: Lathe: Description, types, operations, accessories, attachments and machine time calculations. Introduction to Capstan and Turret Lathe and Automatic Machine. Drilling: Description, types of drilling machines, drilling operations, machine time Calculations

UNIT-IV

Milling: Description, types of milling machines, Mounting of milling cutters, types of milling operations, machining time calculation, types of indexing methods. Gear cutting process, Gear Milling , Thread Milling, Shaping, Planning and Slotting: Description, types of machines and operations, tool setting and quick return mechanisms. Machining time calculations.

UNIT V

Grinding machine –Theory of grinding – classification of grinding machine – cylindrical and surface grinding machine – Tool and cutter grinding machine – special types of grinding machines – Grinding wheel, Different types of abrasives – bonds, specification and selection of a grinding wheel

Principles of design of Jigs and fixtures and uses. Classification of Jigs & Fixtures – Principles of location and clamping – Types of clamping & work holding devices.

TEXT BOOKS :

1. R.K. Jain, *Engineering Metrology*, Khanna Publications, 2008.

2. I.C. Gupta, *A Text Book of Engineering Metrology*, Dhanpat Rai & Sons, 1984.

3. Metal cutting and machine tools by P.N.Rao.

4. Workshop Technology by S.K.HAJRA CHOUDHURY

5. Ghosh and Mallik, Manufacturing Science, Affiliated East-West Press, New Delhi.

REFERENCES:

1. Fundamentals of Dimensional Metrology , Connie Dotson,4th Ed, Thomson

2. Machine Tools – C.Elanchezhian and M. Vijayan /Anuradha Agencies Publishers.

3. Manufacturing Technology-KalpakJian- Pearson

4. P.C.Sharma, Production Engineering, Dhanpat Rai & Sons, New Delhi.

Category: **Professional Core Course** Subject Code**: 19ME2801**

Fluid Mechanics & Hydraulic Machinery Laboratory

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **0 - 0 - 2 - 1**

Objectives:

- To understand the principles and performance characteristics of flow devices
- To know about the measurement of the fluid properties

Course Outcomes:

The students who have undergone the course will be able to measure various properties of fluids and characterize the performance of fluid machinery

List of the Experiments:

1. Measurement of Coefficient of Discharge of given Orifice meter
2. Measurement of Coefficient of Discharge of given Venturi meter
3. Measurement of frictional losses in a given pipe
4. Determination of the performance characteristics of a multistage centrifugal pump
5. **Bernouli's experiment**
6. **Calibration of Rotameter**
7. Measurement of velocity of flowing fluid using pitot tube
8. Determination of the performance characteristics of Pelton Wheel
9. Determination of the performance characteristics of Francis Turbine
10. Determination of the performance characteristics of Kaplan Turbine
11. **Impact of jet experiment**

Category: **Professional Core Course** Subject Code**: 19ME2802**

Metrology and Instrumentation Laboratory

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **0 - 0 - 2 - 1**

List of Experiments in Metrology:

1. Measurement of Length, Height, Depth and Diameter by Veriner Caliper, Veriner Depth Micrometer Screw gauge
2. Angular Measurement by Bevel Protractor.
3. Angular Measurement by Sine Bar and Slip gauges.
4. Study and Applications of Surface Roughness Tester
5. Study and Applications of Profile Projector
6. Study and Applications of Tool Maker's Microscope

List of Experiments in Instrumentation:

Sl.No.	Name of the Experiment
1.	Calibration of Pressure Gauge using Dead Weight Tester (DWT)
2.	Measurement of displacement using Full bridge Strain Gauge circuit
3.	Measurement of displacement using Linear Variable Differential Transformer (LVDT)
4.	Motor speed measurement using Magnetic Pick Up Sensor, Photo Reflector Sensor, Photo Interruptive Sensor and Hall Effect Sensor
5.	Measurement of Torque Generated by AC (Induction motor) using Force Transducer.
6.	Weight measurement using Load cell
7.	Static Torque Measurement by using load cell.
8.	Measurement of Pressure using Transducer
9.	Strain measurement using strain gauges and cantilever assembly

Category: **Professional Core Course** Subject Code**: 19ME2803**

Manufacturing Process Laboratory

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **0 - 0 - 2 - 1**

List of experiments:

I. Casting:

1. Pattern design and preparation
2. Moulding properties like permeability, Green hardness, Dry tensile & compression strength, Green tensile & compression strength, Moisture measurement.
3. Riser design & sieve analysis.

II. Forming

1. Simulation of Extrusion & deep drawing process

III. Welding:

1. Arc welding characteristics
2. Characteristics of MIG welding
3. Demo of TIG and Resistance spot welding

IV. Machining:

1. Milling of Spur gear
2. Effect of process parameter and machining on shear angle in orthogonal cutting on chip formation in turning
3. Effect of process parameters in turning on cutting forces & temperatures
4. Grinding of single point cutting tool

Course Structure for III B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester V						
Subject Code	Subject	SSN	L	T	P	C
19ME3101	Applied Thermodynamics	PCC	3	1	0	4
19ME3102	Dynamics of Machinery	PCC	3	1	0	4
19ME3103	Design of Machine Members	PCC	3	1	0	4
19ME3xxx	Professional Elective-1	PEC	3	0	0	3
19ME3xxx	Professional Elective-2	PEC	3	0	0	3
19ME3701	Applied Thermodynamics Lab	PCC	0	0	2	1
19ME3702	Theory of Machines Lab	PCC	0	0	2	1
19ME3703	Computer Aided Machine Drawing Practice	PCC	0	0	3	1.5
19ME3001	Mini Project-I		0	0	2	1
	Total		**15**	**3**	**7**	**22.5**

Category: **Professional Core Course** Subject Code**: 19ME3101**

Applied Thermodynamics

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 1 - 0 - 4**

Objectives:

(1) To learn about of I law for reacting systems and heating value of fuels

(2) To learn about gas and vapor cycles and their first law and second law efficiencies

(3) To learn about gas dynamics of air flow and steam through nozzles

(4) To learn about bolier working principle and mountings, accessories

(5) To analyze the basic concepts of steam turbines, operational principles and performance of steam turbines and their operational principles

Outcomes:

1. After completing this course, the students will get a good understanding of various practical power cycles and heat pump cycles.
2. They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines
3. They will be able to understand phenomena occurring in high speed compressible flows
4. They will understand the design and performance criteria for steam turbines

UNIT-1:

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

UNIT-2:

Vapor power cycles Rankine cycle with superheat, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance, reheat and regeneration,exergy analysis.

Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, essential components – parameters of performance – actual cycle – effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles

UNIT-3:

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser. Boilers and Classification based on Working principles & Pressures of operation -L.P & H.P.Boilers – Mountings and Accessories – Boiler horse power, equivalent evaporation, efficiency and heat balance – **Draught**: classification – Height of chimney for given draught and discharge, condition for maximum discharge, efficiency of chimney – artificial draught, induced and forced draught.

UNIT-4:

UNIT-5:

Analysis of steam turbines, velocity and pressure compounding of steam turbines, Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.

2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India

3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.

4. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd

Category: **Professional Core Course** Subject Code**: 19ME3102**

Dynamics of Machinery

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

COURSE OBJECTIVES:

- To find static and dynamic forces on planar mechanisms.
- To know the causes and effects of unbalanced forces in machine members.
- To determine natural frequencies of undamped, damped and forced vibrating systems of one, two and multi degree freedom systems.

COURSE OUTCOMES:

- Able to analyze the planar mechanism by performing static and dynamics force analysis.
- Able to apply gyroscopic principles on Aero plane, ship, four wheel and two wheel vehicles
- Able to understand the basic concepts of friction in inclined plane, in screw and nuts, pivots and collars with uniform pressure and uniform wear
- Able to understand how to draw turning moment diagram and can design a flywheel for IC engine
- Able to understand the basics concepts of governors and forces acting on various governors and able to solve numerical problems on different governors
- Able to balance rotating and reciprocating mass in various planes and able to understand balancing of V- engine and multi cylinder engines
- Able to perform analysis of the response of one degree of freedom systems with free and forced vibrations and can evaluate the critical speed of the shaft and can understand torsional vibrations
- Able to understand two and three rotor systems and can solve simple vibration calculations of rotor systems.

UNIT – I

Static and Dynamic force analysis: Analysis of four bar and slider crank mechanism, Inertia Forces of a Reciprocating Engine Mechanism

Flywheel: Turning moment diagram for steam engine, I.C. engine and multi cylinder engine. Crank effort - coefficient of Fluctuation of energy, coefficient of Fluctuation of speed – Fly wheels and their design.

UNIT –II

Gyroscope: effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes and ships.

Governors: Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting –effort and power of a governor.

UNIT – III

Balancing: Balancing of rotating masses - single and multiple – single and different planes.

Balancing of Reciprocating Masses: Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples – V, multi cylinder, in -line and radial engines for primary and secondary balancing, locomotive balancing – Hammer blow, Swaying couple, variation of tractive force.

UNIT – IV

Brakes*:* block brakes, band brakes, band and block brakes, internal expanding brake.

Dynamometers: Introduction, types - prony, rope brake, epi-cyclic, Bevis Gibson and belt transmission dynamometers.

UNIT – V

Vibrations: Introduction, types of vibrations, free longitudinal vibrations, damped vibrations, logarithmic decrement, forced vibrations, vibrations isolation and transmissibility, transverse vibrations, whirling of shafts, critical speeds.

TEXT BOOKS:

1. Theory of Machines / S.S Rattan/ Mc. Graw Hill Publ.

2. Theory of machines / Khurmi/S.Chand.

REFERENCES:

1. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age

2. Dynamics of Machinery/Balleney/Dhanpat Rai

3. Theory of Machines / Thomas Bevan / CBS Publishers

4. Theory of Machines / Jagadish Lal & J.M.Shah /Metropolitan.

Category: **Professional Core Course** Subject Code**: 19ME3103**

Design of Machine Members

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

Course Objectives:

1. To understand and apply the basics of mechanics of materials and ergonomics.

2. To learn design of machine components subjected to static and fatigue loading

3. To develop an ability to design different machine elements.

4. To design a machine which satisfies given requirements within the specified constraints.

5. To develop an ability to identify, formulate, and solve engineering problems.

Course Outcomes:

1. Students will be able to apply the knowledge of stress analysis, theories of failure, manufacturing and material science, and ergonomics principles in design of machine elements.
2. Student will be able to analyze the stress and strain on mechanical components under different loadings; and understand, identify and quantify failure modes for mechanical parts.
3. Students will be able to design various machine elements such as shafts, temporary and permanent fasteners, couplings, belt drives and pressure vessels.
4. Students will be able to make proper assumptions, perform correct analysis and finally decide the size of machine elements while giving due consideration to material, manufacturing method and cost of the element.
5. With a given practical situation, students will be able to approach design problem successfully, and will be able to take decisions when no unique solution exists.

Unit-I

Introduction, Materials used in machine design and their specifications to Indian standards. Important mechanical properties of materials used in design. Codes and standards used in design. Reliability, Principles of good Ergonomic Design, Manufacturing considerations. Preferred numbers.

Analysis of Stress and Strain : Definition of stress and strain, Types of loading, Direct normal stress, bending stress, Torisonal stress, crushing and bearing stresses, Biaxial stress and Triaxial stress.

Theories of elastic failure, Stress concentration factor, factor of safety, Design of components for static loads, Introduction to thermal stresses.

Unit-II

Design for Fatigue and Impact loads; Importance of fatigue in design, Fluctuating stresses, fatigue strength and endurance limit. Factors affecting fatigue strength. S-N Diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue, Miner's rule, Design of components for fatigue. Design of components for impact loading.

Unit-III

Design of keys, shafts – solid, hollow shafts and splined shafts under torsion and bending loads. Design of belt drive systems, selection of belts and design of pulleys.

Unit-IV

Design of cotter and knuckle joints, riveted and welded joints under direct and eccentric loading. Design of couplings – Muff and Split Couplings, Flange, Flexible and Marine type of couplings.

Unit-V

Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints, design of power screws and screw jack. Thick and thin cylinders.

Suggested Reading

1. V.B. Bhandari, *Machine Design*, Tata Mc Graw Hill Publication, 1991.

2. J.E. Shigley, C.R. Mischne, *Mechanical Engineering Design*, Tata Mc Graw Hill Publications, 2003.

3. Robert C. Juvinall, *Fundamentals of Machine Component Design*, John Wiley & Sons, 2005

4. Robert L. Norton, *Machine Design: An Integrated Approach*,2/e Pearson Education, 2000

5. M.F. Spotts, *Design of Machine Elements*, Prentice Hall of India, 1964.

REFERENCES:

1. Machine design- J.E.Shigley

2. Machine design- R S Khurmi and J K Gupta

3. Design Of Machine Elements - M.F.Spotts-PHI

4. Machine Design - Kannaiah/ Scietech.

Category: **Professional Core Course** Subject Code**: 19ME3701**

Applied Thermodynamics Laboratory

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **0 - 0 - 2 - 1**

List of experiments:

1. To study Vapour Compression Refrigeration cycle with the help of refrigeration circuit under variable load conditions
2. To determine the Coefficient of Performance, Refrigeration capacity & Compressor work of Vapour Compression Refrigeration cycle with the help of refrigeration circuit under variable load conditions
3. To study Vapour Absorption Refrigeration cycle
4. To determine the Coefficient of Performance, Refrigeration capacity & Compressor work of Vapour Absorption Refrigeration cycle
5. To compare heat transfer for different heating elements in a cross flow heat exchanger
6. To study fundamental principles and various controls used in room air conditioning
7. To study different psychometric processes and estimating the change of state of air using air conditioner and illustrating them on psychometric diagram
8. Study on the characteristics of flame stability and methods to improve stability limits
9. Determination of flame speed based on the cone method
10. Determination of the relationship between flame speed and air/fuel ratio flame separation demonstration

Category: **Professional Core Course** Subject Code**: 19ME3702**

Theory of Machines Laboratory

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **0 - 0 - 2 - 1**

S. No	Experiment
1.	To find experimentally the Gyroscopic couple on Motorized Gyroscope and compare with applied couple.
2.	To find out critical speed experimentally and to compare the Whirling Speed of a shaft with theoretical values
3.	To determine experimentally, the Moment of Inertia of a Flywheel and Axle compare with the theoretical values.
4.	To calculate the torque on a Planet Carrier and torque on internal gear using epicyclic gear train and holding torque apparatus.
5.	To perform the experiment of Balancing of rotating parts and find the unbalanced couple and forces
6.	To find out experimentally the coriolli's component of acceleration and compare with theoretical values.
7.	Working models of various types of gears-Spur, Helical, cross helical, worm, bevel gear
8.	Working model of a synchromesh gear box.
9.	Working models of various commonly used mechanisms and its inversions
10.	To determine the frequency of undamped free vibration of an equivalent spring mass system.
11.	To determine the frequency of damped force vibration of a spring mass system
12.	Dynamic force analysis of 4 bar mechanism and slider crank mechanism (Analytical Methods)
13.	To evaluate the performance on spring controlled governors.
14.	To evaluate the performance on gravity controlled governors
15.	To determine the natural frequency of undamped torsional vibration of a single rotor shaft system.

Category: **Professional Core Course** Subject Code**: 19ME3703**

Computer Aided Machine Drawing Practice

Internals: 50 Marks **L - T - P - C**
Externals: 50 Marks **0 - 0 - 3 - 1.5**

Objectives:

- To understand format of drawing sheet, angle of projections and practice of simple machine elements
- To practice free hand sketching of machine elements
- To understand assembly drawings of typical machine parts such as Connecting rod, Eccentric, Cross head, Machine vice, Screw jack, Non-return valves, Safety valves, Bearings, Tail stock etc.

I. Machine Drawing Conventions:

Need for drawing conventions – introduction to IS conventions

a) Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.

b) Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.

c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.

d) Title boxes, their size, location and details – common abbreviations & their liberal usage

e) Types of Drawings – working drawings for machine parts.

II. Drawing of Machine Elements and simple parts

Selection of Views, additional views for the following machine elements and parts with every drawing proportions.

a) Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.

b) Keys, cottered joints and knuckle joint.

c) Rivetted joints for plates

d) Shaft coupling, spigot and socket pipe joint.

e) Journal, pivot and collar and foot step bearings.

III. Assembly Drawings:

Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions.

a) Engine parts – stuffing boxes, cross heads, Eccentrics, Petrol Engine connecting rod, piston assembly.

b) Other machine parts – Screws jacks, Machine Vices Plummer block, Tailstock.

c) Valves : Steam stop valve, spring loaded safety valve, feed check valve and air cock.

NOTE : First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

TEXT BOOKS :

Machine Drawing – Dhawan, S.Chand Publications

Machine Drawing - K.L.Narayana, P.Kannaiah & K. Venkata Reddy, New Age Publishers

REFERENCES :

Machine Drawing – P.S.Gill.

Machine Drawing – Luzzader

Machine Drawing – Rajput

Textbook of Machine Drawing –K.C.John, 2009, PHI learning

Course Structure for III B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester VI						
Subject Code	Subject	SSN	L	T	P	C
19ME3201	Heat Transfer	PCC	3	1	0	4
19ME3202	Design of Transmission Elements	PCC	3	0	0	3
19ME32xx	Professional Elective-3	PEC	3	0	0	3
19ME32xx	Professional Elective-4	PEC	3	0	0	3
	Managerial Economics And Financial Analysis	HSMC	3	0	0	3
19ME3801	Heat Transfer Lab	PCC	0	0	2	1
19ME3802	Computer Aided Design LAB	PCC	0	0	3	1.5
18BS3201	Environmental Science		3	0	0	0
19ME3002	Project – II		0	0	6	3
	Total		**18**	**1**	**11**	**21.5**

Category: **Professional Core Course** Subject Code**: 19ME3201**

Heat Transfer

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 1 - 0 - 4**

Course objective:

- To understand the basic concepts of heat transfer.
- To study the concepts of conduction, convection, radiation and heat exchangers applicable for commercial and industrial use.
- To study and solve problems on different modes of heat transfer which are related to thermal power plants, refrigeration and air conditioning.

COURSE OUTCOMES:

- Able to grasp the concept of steady state conduction. Student can learn representing conduction equation in various forms
- Able to understand the concept of extended surfaces and its applications. Also, will aware transient heat conduction and how it vary w.r.t time.
- Expected to develop the ability to formulate practical conduction heat transfer problems by transforming the physical system into a Mathematical model and selecting an appropriate solution technique and evaluating the significance of results
- Able to formulate practical forced and natural convection heat transfer problems by transforming the physical system into a mathematical model.
- Able to calculate heat transfer in condensation and boiling systems, turbulent and laminar film condensation.

UNIT – I:

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –General applications of heat transfer.

Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates.

UNIT – II:

Simplification and forms of the field equation – steady, unsteady and periodic heat transfer – boundary and Initial conditions.

One Dimensional Steady State Heat Conduction: in Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – Critical radius/thickness of insulation-with Variable Thermal conductivity –with internal heat sources or Heat generation. Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to errors in Temperature measurement.

One Dimensional Transient Heat Conduction: in Systems with negligible internal resistance – Significance of Biot and Fourier Numbers - Chart solutions of transient conduction systems- Problems on semi-infinite body.

UNIT – III:

Convective Heat Transfer: Dimensional analysis–Buckingham π Theorem and its application for developing semi – empirical non- dimensional correlations for convective heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations.

Forced convection: External Flows: Concepts of hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer for flow over-Flat plates, Cylinders and spheres..

Internal Flows: Division of internal flow through Concepts of Hydrodynamic and Thermal Entry Lengths – Use of empirical relations for convective heat transfer in Horizontal Pipe Flow, annular flow.

Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate – Use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation.

UNIT IV:

Heat Transfer with Phase Change: Boiling: Pool boiling – Regimes, determination of heat transfer coefficient in Nucleate boiling, Critical Heat flux and Film boiling.

Condensation: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

Heat Exchangers:

Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT V:

Radiation Heat Transfer

Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities– laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between gray bodies – radiation shields– electrical analogy for radiation networks.

TEXT BOOKS:

1. Fundamentals of Engg. Heat and Mass Transfer / R.C. Sachdeva / New Age International
2. Fundamentals of Heat and Mass Transfer/M.Thirumaleswar/Pearson Edu.

REFERENCE BOOKS:

1. Heat Transfer – P.K.Nag/ TMH

2. Heat Transfer / Holman .J.P/TMH

3. Heat and Mass Transfer –Cengel- McGraw Hill.

4. Heat and Mass Transfer – R.K. Rajput – S.Chand & Company Ltd.

5. Heat and Mass Transfer-Kondandaraman

Category: **Professional Core Course** Subject Code**: 19ME3202**

Design of Transmission Elements

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Course objective:

- To learn design criteria of machine components, selection of materials and manufacturing process.
- To learn application of principles to design helical coiled and leaf springs, gears, clutches, brakes, sliding contact and rolling element bearings, IC engine components and fly wheels.

COURSE OUTCOMES:

- Students are able to design helical coiled springs used for two wheel vehicle and laminated springs for trucks
- Students are able to design spur, helical, bevel and worm gears for different input conditions and able to identify which gears can be used in the various applications
- Students are able to design journal bearings, roller bearings and ball bearings and to know the advantages of rolling contact bearings over sliding contact bearings
- Students are able to know the importance of clutches, brakes and able to design different types of clutches and brakes
- Students are able to identify the various forces acting on the I.C engine parts, failure criteria to be adopted for different parts
- Able to know the importance of fly wheel in engines and able to design the fly wheel

Unit-I

Mechanical springs: Introduction. Different types of springs. Materials used for springs.

Helical Springs: waal factor, calculation of stress, Deflection and energy stored in spring. Design for static and fluctuating loads.

Leaf Springs: Stress and Deflection. Nipping of Leaf springs. Design for static and fluctuating loads.

Unit-II

Gears: Introduction of gear drives, different types of gears, Materials used for gears. Standards for gears and specifications.

Spur Gear Design: Lewis equation, Beam strength of gear tooth and static design. Wear load and design for Wear. Dynamic loads on gear tooth. Design of Helical, Bevel and Worm gears, concepts of Design for manufacturability.

Unit-III

Bearings: Introduction. Materials used for Bearings. Classification of bearings and mounting of bearings.

Design of sliding contact bearings: Properties and types of Lubricants, Design of Hydrostatic and Hydrodynamic sliding contact bearings.

Design of Rolling Contact Bearings: Different types of rolling element bearings and their constructional details, static load carrying capacity. Dynamic load carrying capacity .Load-life relationship, selection of bearing life. Design for cyclic loads and speeds. Design of Ball and Roller bearings.

Unit-IV

Design of Clutches and Brakes: Clutches: Introduction, Types of clutches, Material, Design of a disc or plate clutch, Multiple disc clutch, Cone clutch, Centrifugal clutch. Brakes: Introduction, Design of Single blocks or shoe brake, Pivoted block or shoe brake, Double blocks or shoe brake, Simple band brake, Differential band brake, Band and block brake &, Internal expanding brake.

Unit-V

I.C. Engine parts: Introduction. Materials used. Design of piston, connecting rod and crank for I.C. Engines.

Fly wheels: Introduction. Design of solid disk type and rimmed fly wheels.

Suggested Reading

1. Bhandari V.B. *Machine Design*, Tata McGraw Hill Publications, 1994.

2. J.E. Shigley , C.R. Misckhe, *Mechanical Engineering Design*, Tata McGraw Hill Publication, 2003.

3. P. Kannaiah, *Machine Design*, Science-Tech Publications, 2003.

4. M.F. Spotts, *Design of Machine Elements*, Prentice Hall, 1964.

5. Robert L. Norton, *Machine Design: An Integrated Approach*,2/e PearsonEducation, 2000

Category: **HSM Course** Subject Code**: BM3001**

MANAGERIAL ECONOMICS & FINANCIAL ANALYSIS

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 0 - 0 - 3**

Course Objective:

- Enable the students to learn managerial economics principles applied in industries and equip them to handle the tasks in their career by making a real sense of what is happening economically in the organization.
- The course describes the Nature and Scope of Managerial Economics. It gives complete study on the demand and elasticity of demand and methods of demand forecasting.
- It provides a detailed structure on the pricing strategies and shows clear picture methods and sources of raising finance.
- It gives clear cut information of preparing final accounts and capital Budgeting techniques.

Course Outcome: After the successful completion of this course, the learner will be able to know:

1. The dynamic game of demand and supply, and how the trinity of Economics i.e. Demand, Supply and Scarcity make the things move around the globe.
2. Principles of Microeconomics applied to industries.
3. Concept of forecasting and applying forecasting techniques to address the challenges and opportunities in the organization they work.
4. Cost and Production analysis, Break-Even analysis, Opportunity Cost, how to optimize organizational resources and how to minimize cost and maximize production, revenue and profit
5. Different pricing structure and discount mechanism suitable for business firms.
6. Market structure and how to exploit market structure for optimizing the benefits of organization.
7. Capital requirements and sources of capital.

UNIT I:

Introduction to Managerial Economics

Definition, Nature and Scope of Managerial Economics-Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting

UNIT II:

Theory of Production and Cost Analysis

Production Function - Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs. Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale.000

Cost Analysis: Cost concepts, Opportunity cost. Fixed vs. Variable costs, Explicit costs Vs. Implicit costs. Out of pocket costs vs. Imputed costs. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems)- Managerial Significance and limitations of BEA

UNIT III:

Markets & Pricing Policies

Market structures: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. Objectives and Policies of Pricing- Methods of Pricing: Cost Plus Pricing. Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing

UNIT IV:

Introduction to Financial Accounting

Introduction to Financial Accounting: Double entry Book Keeping, Journal, Ledger, Trail Balance and Final Accounts (Trading account, Profit and Loss Account and Balance sheet with sim1vbple adjustments).

UNIT V:

Capital and Capital Budgeting

Capital and Capital Budgeting: Capital and its significance. Types of Capital. Estimation of Fixed and Working capital requirements. Methods and sources of raising finance. Nature and scope of capital budgeting, features of capital budgeting proposals. Methods of Capital Budgeting: Payback Method. Accounting Rate of Return (ARR) and Net Present Value Method, Internal Rate of Return (IRR).

Reference Books:

1. Aryasri: Managerial Economics and Financial Analysis, TMH,2009.
2. Varshney & Maheswari : Managerial Economics, Sulthan Chand,2009.
3. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis, Scitech. 2009.
4. V.Rajasekarn & R.Lalitha. Financial Accounting, Pearson Education. New Delhi. 2010
5. Suma Damodaran, Managerial Economics, Oxford University Press. 2009.

Category: **Mandatory Course** Subject Code**: 18BS3201**

ENVIRONMENTAL SCIENCE

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 0**

Learning Objectives:

1. Stimulate interest in the environment and endeavours to generate awareness about environmental concerns among students.
2. Develop an understanding of how natural resources and the environment affect quality of life and the quest for sustainable development.
3. Develop knowledge and understanding of environmental issues and principle and apply their knowledge to mitigate the environmental problems.
4. Understand and resolve some of today's most challenging scientific and policy issues—including global climate change, pollution, biodiversity conservation, sustainability, environmental pollution and toxic waste disposal, disease control, disaster management, socio-environmental issues and balancing resource use and preservation.
5. Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.
6. Recognizes the global changes and responses for attaining a more sustainable environment.

LEARNING OUTCOMES:

The Environmental Science minor supplements other majors to facilitate students' understanding of complex environmental issues from a problem-oriented, interdisciplinary perspective. Students:

- ❖ Understand core concepts and methods from ecological and physical sciences and their application in environmental problem-solving.
- ❖ Appreciate key concepts from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
- ❖ Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- ❖ Appreciate that one can apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
- ❖ Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex.

UNIT 1:

MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, scope and importance, need for public awareness.

UNIT 2:

NATURAL RESOURCES:

Renewable and non-renewable resources : Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- .Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

UNIT 3:

ECOSYSTEMS & BIODIVERSITY

Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystems:-

a. Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).
b. Biodiversity- Definition : genetic, species and ecosystem diversity. Biogeographical classification of India Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values.
c. Biodiversity at global, National and local levels. Inida as a mega-diversity nation Hot-sports of biodiversity.

d. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT 4:

ENVIRONMENTAL POLLUTION

Definition, Cause, effects and control measures of :- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards

- Solid waste Management: Causes, effect s and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution
- Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
- Environment Protection Act., Air (Prevention and Control of Pollution) Act. Water Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act .

UNIT 5 :

SOCIAL ISSUES & THE ENVIRONMENT

Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Field work : Visit to a local area to document t environmental assets river/ forest/grassland/hill/mountain Visit to a local polluted site-Urban/Rural/Industrial/Agricultural . Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc.

REFERENCES :

a). Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.

b). Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad- 380 013, India, Email:mapin@icenet.net (R)

c). Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p

d) Clark R.S., Marine Pollution, Clanderson Press Oxford (TB) e). Cunningham, W.P. Cooper, T.H. Gorhan i, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 116p .

Category: **Professional Core Course** Subject Code**: 19ME3801**

Heat Transfer Laboratory

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **0 - 0 - 2 - 1**

Course Educational Objectives:

- To understand the principles of conduction, convection and radiation heat transfer and their applications in the design of heat exchangers and insulations.

Course Outcomes:

Students undergoing this course are able to

- Design of experiments to study thermal power cycles and other thermal systems including compressors, turbines and combustion systems.

<u>LIST OF EXPERIMENTS</u>

1. Evaluation of thermal conductivity using lagged pipe apparatus.
2. Determination of thermal conductivity using guarded plate apparatus.
3. Evaluation of Stefan Boltzmann Constant.
4. Determination of radiation from a grey body.
5. Determination of heat transfer co-efficient using pin-fin apparatus.
6. Evaluation of COP of refrigerant
7. Experiment on parallel flow heat exchanger
8. Experiment on counter flow heat exchanger
9. Determination of convective heat transfer coefficient during natural convection.
10. Determination of convective heat transfer coefficient during forced convection.
11. Study of air-conditioning test rig
12. Study of air blower
13. Study of air compressor

Category: **Professional Core Course** Subject Code**: 19ME3802**

CAD Laboratory

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **0 - 0 - 3 - 1.5**

1. **AUTOCAD**

   1.1 Introduction, Draw tools, Modify tools

   1.2 Introduction, Dimensions, Text, Layers, Blocks

2. **SOLID WORKS:**

   2.1 Introduction, Sketch tools, Modify tools, Part modeling, Part modification

   2.2 Assembly drawing, Cotter joint, Universal joint, Old hams coupling

   2.3 Drawing

3. **FUSION 360**

   3.1 Introduction, Sketch tools, Modify tools, Part modeling

   3.2 Assembly drawing, Knuckle joint, Piston –connecting rod –crank

   3.3 Simulation

4. **ANSYS**

   4.1 Static structural analysis of parts

   4.2 Static structural analysis of assembly

Course Structure for IV B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester VII						
Subject Code	Subject	SSN	L	T	P	C
19ME4101	Automation in Manufacturing	PCC	3	0	0	3
19ME4102	Industrial Engineering	HSMC	3	0	0	3
19ME41xx	Professional Elective-5	PEC	3	0	0	3
	Open Elective-1	OEC	3	0	0	3
	Open Elective-2	OEC	3	0	0	3
19ME4701	Automation in Manufacturing Lab	PCC	0	0	2	1
19ME4001	Project – III		0	0	10	5
	Total		**15**	**0**	**12**	**21**

Category: **Professional Core Course** Subject Code**: 19ME4101**

Automation in Manufacturing

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Course Objectives:

1. To understand the importance of automation in the of field machine tool based manufacturing
2. To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC.
3. To understand the basics of product design and the role of manufacturing automation

Course Outcomes:

Upon completion of this course, the students will get a comprehensive picture of computer based automation of manufacturing operations

UNIT I:

Introduction: Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools.

UNIT II:

Flexible automation: Computer control of Machine Tools and Machining Centers, NC and NC part programming, CNC-Adaptive Control, Automated Material handling, Assembly, Flexible fixturing.

UNIT III:

Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC- Adaptive Control

UNIT IV:

Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies

UNIT V:

Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Case studies & industrial applications.

Text Books:

(i) Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prentice Hall
(ii) SeropeKalpakjian and Steven R. Schmid, Manufacturing –Engineering and Technology, 7th edition,Pearson
(iii) YoramKoren, Computer control of manufacturing system, 1st edition
(iv) Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition.

Category: **Professional Core Course** Subject Code**: 19ME4701**

Automation in Manufacturing Lab

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Course Objectives

- To provide hands on experience in MATLAB and to write simple codes to implement the numerical methods.
- To demonstrate the simulation of manufacturing processes using simulation package.
- To demonstrate the working principle and operation of CNC lathe, CNC Mill , Robot and 3D printer.

Learning Outcomes : Upon successful completion of the course, the students will be able to

- Write MATLAB code for numerical methods used in solving ordinary and partial differential equations
- Simulate manufacturing processes and produce simple components using CNC lathe , CNC Mill and 3 D printer.
- Operate Robot and write code for Palletization of components.

List of Experiments

1. Simulation of manufacturing Processes.
2. Machining of Components using CNC Lathe.
3. Machining of Components using CNC Mill.
4. Welding of materials by MIG and TIG
5. Palletization of objects using pick and place Robot.
6. Manufacturing of simple components using 3D Printer.
7. Determination of roots of the Algebraic equations using Newton Raphson Method.
8. Implementation of Newton's Forward Interpolation formula.
9. Implementation of Gauss Backward Interpolation formula.
10. Implementation of Langranges Interpolation formula.
11. Implementation of Numerical Differentiation methods.
12. To plot variation of displacement, velocity and acceleration of coupler and output link for four bar mechanism.
13. Solving boundary value and initial value problem differential equations with simulink model .

Course Structure for IV B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester VIII						
Subject Code	Subject	SSN	L	T	P	C
19ME42xx	Professional Elective-6	PEC	3	0	0	3
	Open Elective-3	OEC	3	0	0	3
19ME4801	Comprehensive Viva	PCC	0	0	0	1
19ME4002	Project – IV		0	0	12	6
	Total		**6**	**0**	**12**	**13**

List of Professional Electives

Sl. No	Code	Subject	Semester	L-T-P	Credits
		3rd Year Sem1			
1.	19ME3111	Internal Combustion Engines	V	3-0-0	3
2	19ME3112	Non Traditional Manufacturing Process	V	3-0-0	3
3	19ME3113	Power Plant Engineering	V	3-0-0	3
4	19ME3114	Powder Metallurgy	V	3-0-0	3
5	19ME3115	Mechanics of Composite Materials	V	3-0-0	3
6	19ME3116	Advanced Mechanics of Solids	V	3-0-0	3
7	19ME3117	Mechanical Behaviour of Materials	V	3-0-0	3
8	19ME3118	Gas Dynamics and Jet Propulsion	V	3-0-0	3
9	19ME3119	Bio-Medical Engineering	V	3-0-0	3
3rd Year Sem2					
10	19ME3211	Computer Aided Design	VI	3-0-0	3
11	19ME3212	Theory of Elasticity	VI	3-0-0	3
12	19ME3213	Production Planning & Control	VI	3-0-0	3
13	19ME3214	Advanced Fluid Mechanics	VI	3-0-0	3
14	19ME3215	Mechanical Vibrations	VI	3-0-0	3
15	19ME3216	Micro and Nano Machining	VI	3-0-0	3
16	19ME3217	Computational Fluid Dynamics	VI	3-0-0	3
17	19ME3218	Conduction and Radiation Heat Transfer	VI	3-0-0	3
		4th Year Sem1			
18	19ME4111	Refrigeration and Air Conditioning	VII	3-0-0	3
19	19ME4112	Tribology	VII	3-0-0	3
20	19ME4113	Mechanics of Sheet Metal Forming	VII	3-0-0	3
21	19ME4114	Convective Heat And Mass Transfer	VII	3-0-0	3
22	19ME4115	Advanced Engineering Thermodynamics	VII	3-0-0	3
23	19ME4116	Theory of Combustion and Emissions	VII	3-0-0	3
24	19ME4117	Mechanical Handling Systems And Equipments	VII	3-0-0	3
25	19ME4118	Phase Transformation and Heat Treatment of Materials	VII	3-0-0	3
26	19ME4119	Technology of Surface Coating	VII	3-0-0	3
27	19ME4120	Fatigue, Creep and Fracture	VII	3-0-0	3
		4th Year Sem2			
28	19ME4211	Welding Technology	VIII	3-0-0	3
29	19ME4212	Laser Applications in Manufacturing	VIII	3-0-0	3
30	19ME4213	Introduction to MEMS	VIII	3-0-0	3
31	19ME4214	Experimental Stress Analysis	VIII	3-0-0	3
32	19ME4215	Design Optimization	VIII	3-0-0	3

Category: **Professional Elective Course** Subject Code**: 19ME3111**

Internal Combustion Engines

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 -3**

Unit I:

Spark Ignition EnginesSpark ignition Engine mixture requirements -Feedback Control Carburetors – Properties of Fuel -Injection systems -Monopoint and Multipoint injection –Gasoline Direct Injection – Ignition Systems-Stages of combustion -Normal and Abnormal combustion-Factors affecting knock - Combustion Chambers.

Unit II:

Compression Ignition EnginesStates of combustion in C.I. Engine -Direct and indirect injection systems – Combustion chambers -Properties of Fuel -Fuel spray behavior -spray structure -spray penetration and evaporation –Air motion -Turbocharging –Cooling and Lubriction Systems.

Unit III:

Engine emissions and their controlPollutant -Sources and types -formation of NOx -Hydrocarbon Emission Mechanism -Carbon Monoxide Formation -Particulate emissions -Methods of controlling Emissions-Catalytic converters and Particulate Traps-Selective Catalytic Reduction(SCR)-Diesel Oxidation Catalyst(DOC)-Methods of measurements –Emission Norms and Driving cycles.

Unit IV:

Alternate FuelsAlcohol -Hydrogen -Natural Gas and Liquefied Petroleum Gas –Biodiesel-Biogas-Properties -Suitability -Engine Modifications -Merits and Demeritsas fuels.

Unit V:

Recent trends in IC enginesLHR Engines-Learn Burn Engines -Stratified charge spark ignition engine – Homogeneous charge compression Ignition -Plasma Ignition –Electric/Hybrid Vehicles-Electronic Engine Management -Fuel cell vehicles.

Text Books

1. R.B.Mathur and R.P.Sharma, (2002), Internal Combustion Engines., Dhanpat Rai & Sons

References

1. Colin R.Feriguson, and Allan.T.Kirkpatrik, (2000), I.C.engines Applied Thermosciences
2. Ganesan V., (1999), Internal Combustion Engines, Tata McGraw Hill.
3. John B. Heywood, (2000), Internal Combustion Engine Fundamentals, McGraw Hill.
4. Rowland S.Benson and N.D.Whitehouse, (2000) Internal combustion Engines, Vol. I and II, Pergamon Press.

Category: **Professional Elective Course** Subject Code**: 19ME3112**

Non Traditional Manufacturing Process

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 0 - 0 -3**

UNIT— I

Need for Modern Manufacturing Methods: Non-traditional machining methods and rapid prototyping methods - their relevance for precision and lean manufacturing. Classification of non-traditional processes - their selection for processing of different materials and the range of applications.

Introduction to rapid prototyping - Classification of rapid prototyping methods - sterolithography, fused deposition methods - materials, principle of prototyping and various applications.

UNIT—II

Abrasive jet, Water jet and abrasive water jet machining: Basic mechanics of material removal, descriptive of equipment, process variables, applications and limitations.

Ultrasonic machining – Elements of the process, mechanics of material removal, process parameters, applications and limitations.

UNIT – III

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, metal removal rate in ECM, Tooling, process variables, applications, economic aspects of ECM.

Chemical Machining: Fundamentals of chemical machining- Principle of material removal- maskants – etchants- process variables, advantages and applications.

UNIT—IV

Thermal Metal Removal Processes: Basic principle of spark erosion (EDM), Wire cut EDM, and Electric Discharge Grinding processes - Mechanics of machining, process parameters, selection of tool electrode and dielectric fluids, choice of parameters for improved surface finish and machining accuracy - Applications of different processes and their limitations.

Plasma Machining: Principle of material removal, description of process and equipment, process variables, scope of applications and the process limitations.

UNIT-V

Electron Beam Machining: Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes - process mechanics, parameters, applications and limitations.

Laser Beam Machining: Process description, Mechanism of material removal, process parameters, capabilities and limitations, features of machining, applications and limitations.

TEXT BOOK

- Advanced machining processes – VK Jam, Allied publishers.
- Manufacturing processes for engineering materials by Serope Kalpakjian and Steven R Schmid, 5edn, Pearson Pub.

REFERENCES

- Modern Machining Process – Pandey P.C. and Shah H.S., TMH.
- New Technology – Bhattacharya A, The Institution of Engineers, India 1984.
- Unconventional Machining Processes – C. Elanchezhian,, B. Vijaya Ramnath and M Vijayan, Anuradha Publications, 2005.
- Unconventional Manufacturing Processes – M.K. Singh, New Age International Publishers.

Category: **Professional Elective Course** Subject Code**: 19ME3113**

Power Plant Engineering

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 -3**

Unit I:

Introduction to Power Plants

Power plants-Features - Componets and layouts-Working principle of Steam - Hydro - Nuclear - Gas Turbine and Diesel power plants-Selection of site-Analysis of steam cycles-Rankine cycle-Reheating and Regenerative cycles

Unit II:

Steam Generators

Boiler classification-Types of Boiler-Fire tube and Water tube boilers-High pressure and Supercritical boilers-Positive circulation boilers-Fluidized bed boiler-Waste heat recovery boiler-Feed water heaters-Super heaters-Reheaters-Economiser-Condenser-Cooling tower- Feed water treatement-Air heaters

Unit III:

Combustion and Firing Methods

Coal handling and preparation-Combustion equipment and firing methods-Mechanical stokers-Pulverized coal firing systems-Cyclone furnace-Ash handling systems-Electrostatic precipator-Fabric filter and Bag house-Forced draft and Induced draft fans-Chimney

Unit IV:

Nuclear and Gas Turbine Power Plants

Principles of nuclear energy-Energy from nuclear reactions-Energy from fission and fuel Burnup-Decay rates and Half-Lives-Boiling water reactor-Pressurized water reactor- Pressurized Heavy Water Reactor-Gas cooled reactor-High temperature gas cooled reactor- Pebble bed reactor-Fast breeder reactor-Liquid metal fast breeder reactor-reactor materials- Radiation shielding-Waste disposal-Gas turbine power plant-Open and closed cycles- Intercooling - Reheating and Regenerating-Combined cycle power plant

Unit V:

Hydro and Diesel Power Plants

Classification of Hydro-electric power plants and their applications-Selection of prime movers-Governing of turbine-Diesel power plant- Subsystems-Starting and stopping-Heat balance-Supercharging of Diesel engines

Text Books

P. K. Nag, (2001), Power Plant Engineering: Steam and Nuclear, Tata McGraw-Hill

Category: **Professional Elective Course** Subject Code**: 19ME3114**

Powder Metallurgy

Internals: 40 Marks	**L - T - P - C**
Externals: 60 Marks	**3 - 0 - 0 - 3**

UNIT – I:

Introduction, historical background, steps in powder metallurgy, advantages of powder metallurgy process, advantages of powder metallurgy processing over conventional material processing, applications of powder metallurgy, limitations of powder metallurgy, recent trends; **Powder production methods:** Mechanical – milling, machining, other impaction techniques, mechanical alloying, Chemical – reduction, thermal decomposition, hydride-dehydride process, Physical methods – electrolytic deposition, gas atomization, water atomization, centrifugal atomization, other atomization approaches, atomization limitations.

UNIT – II:

Powder treatment and handling: powder treatments – cleaning of powders, grinding, powder classification and screening, blending and mixing; coating of metal powders; **Metal powder characteristics:** sampling, metal powder characterization – chemical composition analysis, particle shape analysis, particle size, measurement techniques – microscopy, screening, sedimentation, light scattering; microstructural features; packing and flow characteristics of powders – angle of repose, flow rate; density – apparent density, tap density; porosity; compressibility of metal powder; strength properties.

UNIT – III: Compaction of metal powders: powder pressing – powder shaping and compaction, binders; powder compaction methods – pressure less compaction techniques, pressure compaction techniques; classification of powder metallurgy parts; cold isostatic compaction – process, types, advantages, applications; powder rolling – steps involved, influence of powder characteristics on powder rolling, advantages, disadvantages, application; miscellaneous compaction techniques – continuous compaction, explosive compaction; **High temperature compaction:** principles of pressure sintering – uniaxial hot pressing, hot extrusion, spark sintering, hot isostatic pressing, injection moulding.

UNIT – IV: Sintering: types of sintering – solid state sintering, liquid phase sintering, activated sintering, reaction sintering, rate controlled sintering, microwave sintering, self propagating high temperature synthesis, gas plasma sintering, spark plasma sintering; sintering theory – thermodynamics of solid state sintering process, stages in solid state sintering, driving force for sintering, sintering mechanisms; variables – process variables, material variables; effects of sintering – dimensional changes, microstructural changes; sintering atmospheres – need for sintering atmosphere, functions of a sintering atmosphere.

UNIT – V: Post sintering operations: introduction, sizing, coining, repressing, resintering, impregnation, infiltration, heat treatment, steam treatment, machining, joining, plating, and other coatings.

Books:

1. Powder metallurgy science – R M German
2. Powder metallurgy science, technology and applications – PC Angelo and R Subramanian

Category: **Professional Elective Course** Subject Code**: 19ME3115**

Mechanics of Composite Materials

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 0 - 0 -3**

UNIT – I

Introduction to composites: Fundamentals of composites - need for composites – Enhancement of properties - classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC, Fiber reinforced composites. Applications of various types of composites.

UNIT – II

Polymer matrix composites: Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Woven fabrics – Non woven random mats – various types of fibres. PMC processes - Hand layup processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding - Resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP).

UNIT III

Metal matrix composites: Characteristics of MMC, Various types of Metal matrix composites Alloy vs. MMC, Advantages of MMC, Limitations of MMC, Metal Matrix.. Effect of reinforcement - Volume fraction – Rule of mixtures. Processing of MMC – Powder metallurgy process - diffusion bonding – stir casting – squeeze casting.

UNIT IV

Ceramic matrix composites: Engineering ceramic materials – properties – advantages – limitations – Monolithic ceramics - Need for CMC – Ceramic matrix - Various types of Ceramic Matrix composites- oxide ceramics – non oxide ceramics – aluminium oxide – silicon nitride – reinforcements – particles- fibres- whiskers. Sintering - Hot pressing – Cold isostatic pressing (CIPing) – Hot isostatic pressing (HIPing).

UNIT V

Advances in composites: Carbon / carbon composites – Advantages of carbon matrix – limitations of carbon matrix Carbon fibre – chemical vapour deposition of carbon on carbon fibre perform. Sol gel technique. Composites for aerospace applications.

Text Books:

1. Mathews F.L. and Rawlings R.D., Composite materials: Engineering and Science, Chapman and Hall,London, England, 1st edition, 1994.

2. Chawla K.K., Composite materials, Springer – Verlag, 1987

Category: **Professional Elective Course** Subject Code**: 19ME3116**

Advanced Mechanics of Solids

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 -3**

Analysis of Stresses and Strains in rectangular and polar coordinates: Cauchy's formula, Principal stresses and principal strains, 3D Mohr's Circle, Octahedral Stresses, Hydrostatic and deviatoric stress, Differential equations of equilibrium, Plane stress and plane strain, compatibility conditions. Introduction to curvilinear coordinates. Generalized Hooke's law and theories of failure. Energy Methods. Bending of symmetric and unsymmetric straight beams, effect of shear stresses, Curved beams, Shear center and shear flow, shear stresses in thin walled sections, thick curved bars. Torsion of prismatic solid sections, thin walled sections, circular, rectangular and elliptical bars, membrane analogy. Thick and thin walled cylinders, Composite tubes, Rotating disks and cylinders. Euler's buckling load, Beam Column equations. Strain measurement techniques using strain gages, characteristics, instrumentations, principles of photo-elasticity.

Texts Books: L. S. Srinath, Advanced Mechanics of Solids, 2nd Edition, TMH Publishing Co. Ltd., New Delhi, 2003.

Category: **Professional Elective Course** Subject Code**: 19ME3117**

Mechanical Behavior of Materials

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Introduction to deformation behaviour: Concept of stresses and strains, engineering stresses and strains, Different types of loading and temperature encountered in applications, Tensile Test - stress-strain response for metal, ceramic and polymer, elastic region, yield point, plastic deformation, necking and fracture, Bonding and Material Behaviour, theoretical estimates of yield strength in metals and ceramics.

Elasticity Theory: The State of Stress and strain, stress and strain tensor, tensor transformation, principal stress and strain, elastic stress-strain relation, anisotropy, elastic behaviour of metals, ceramics and polymers.

Yielding and Plastic Deformation: Hydrostatic and Deviatoric stress, Octahedral stress, yield criteria and yield surface, texture and distortion of yield surface, Limitation of engineering strain at large deformation, true stress and true strain, effective stress, effective strain, flow rules, strain hardening, Ramberg-Osgood equation, stress -strain relation in plasticity, plastic deformation of metals and polymers

Microscopic view of plastic deformation: Crystals and defects, classification of defects, thermodynamics of defects, geometry of dislocations, slip and glide, dislocation generation -Frank Read and grain boundary sources, stress and strain field around dislocations, force on dislocation - self-stress, dislocation interactions, partial dislocations, twinning, dislocation movement and strain rate, deformation behavior of single crystal, critical resolved shear stress (CRSS), deformation of poly-crystals - Hall-Petch and other hardening mechanisms, grain size effect - source limited plasticity, Hall-Petch breakdown, dislocations in ceramics and glasses.

Fracture: Fracture in ceramics, polymers and metals, different types of fractures in metals, fracture mechanics – Linear fracture mechanics -KIC, elasto-plastic fracture mechanics -JIC, Measurement and ASTM standards, Design based on fracture mechanics, effect of environment, effect of microstructure on KIC and JIC, application of fracture mechanics in the design of metals, ceramics and polymers

Deformation under cyclic load - Fatigue: S-N curves, Low and high cycle fatigue, Life cycle prediction, Fatigue in metals, ceramics and polymers

Deformation at High temperature: Time dependent deformation - creep, different stages of creep, creep and stress rupture, creep mechanisms and creep mechanism maps, creep under multi-axial loading, microstructural aspects of creep and design of creep resistant alloys, high temperature deformation of ceramics and polymers

Text Books:

1. G.E. Dieter, "Mechanical Metallurgy", McGraw-Hill, 1986.

2. R.W. Hertzberg, "Deformation and Fracture Mechanics of Engineering Materials", John Wiley and Sons,

Category: **Professional Elective Course** Subject Code**: 19ME3119**

Bio – Medical Engineering

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 -3**

UNIT - I:

Introduction to Bio-Medical Instrumentation

Man instrumentation system-introduction & components, physiological system of the body, sources of bio-electric potentials, resting & action potentials, Electro-Cardiogram(ECG),Electro Encephalogram(EEG), Electro Myogram (EMG), envoked responses.

UNIT - II:

Electrodes & Transducers

Bio-potential electrodes, basic transducers-transduction principles, biochemical transducers, active & passive transducers, transducers of bio-medical applications, pulse sensors, respiration sensors.

UNIT - III:

Cardio-Vascular System & Respiratory System Measurements

The heart & cardiovascular system, Electro-Cardiography, blood pressure measurement, measurement of blood flow & cardiac output, the physiology of the respiratory system, tests & instrumentation for the mechanics of breathing, respiratory therapy equipment.

UNIT - IV:

Patient Care & Monitoring

Elements of intensive care monitoring, patient monitoring displays, diagnosis, calibration & repair ability of patient monitoring equipment, organization of the hospital for patient care monitoring, pace-makers, defibrillators.

UNIT - V:

Diagnostic Techniques & Bio-Telemetry

Principles of ultrasonic measurement, Ultrasonic Imaging, Ultrasonic Diagnosis X-Ray & Radio-Isotope Instrumentations CAT Scan, Emission Computerized Tomography, MRI, Introduction & components of bio-telemetry system.

UNIT - VI:

Monitors, Recorders & Shocking Hazards

Monitors, recorders, shock hazards & prevention, physiological effects & electrical equipment, methods of accident prevention, isolated power distribution system.

Text Books

1. Onkar N. Pandey, Rakesh kumar, “Bio-Medical Electronics and Instrumentation”, S. K. Kataria & Sons, 2007.

2. Cromewell, Wiebell, P.feiffer, “Biomedical instrumentation and measurements”, Prentice-Hall, 1973.

Reference Books

1. Joseph J.Carr, John M.Brown, “Introduction to Bio-Medical Equipment Technology”, Pearson Publications, 4th Edition.

2. Khandapur, “Handbook of Bio-Medical Instrumentation”, TMH, 2nd Edition.

Category: **Professional Elective Course** Subject Code**: 19ME3211**

Computer Aided Design

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 0 - 0 - 3**

Principles of computer aided design; Computer configuration for CAD applications; Computer peripherals for CAD; Computer graphics fundamentals - Points and lines, Three-dimensional transformations and projections, Plane curves, Space curves, Surface description and generation, Hidden line algorithms for wireframe modeling; Surface modeling; Solid modeling; Representation of 3-D objects. B-rep solid modellers and constructive solid geometry; CAD system utilization and application-Hidden surface algorithms and shading; Finite element systems; Computer aided drafting system; Modelling using Solid Modeler (I-Deas) – Introduction, Part Modelling, Creating Geometry, Operations, Modifying parts, Constraints and construct Networks, Surface Modelling, Assembly, Part and Instance, Concurrent Engineering and Data Management; Drafting – Part Design; Programming Exercises - 2D/3D Transformations and Projections, Curves - Surfaces - composite surface, CSG Modelling Tools - B-Rep Modelling Tools, Hidden Line Removal and Hidden Surface Removal.

Text Books:

1. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " Second Edition, Pearson Education, 1999.
2. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.
3. Donald Hearn and M. Pauline Baker "Computer Graphics"'. Prentice Hall, Inc, 1992.
4. Foley, Wan Dam, Feiner and Hughes – "Computer graphics principles & practice" Pearson Education – 2003

Category: **Professional Elective Course** Subject Code**: 19ME3212**

Theory of Elasticity

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT - I:

Elasticity: Introduction: Elasticity - notation for forces and stress - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - differential equations of equilibrium - boundary conditions – Strain Displacement Relations - compatibility equations - stress function

UNIT - II:

Two dimensional problems in rectangular coordinates - solution by polynomials - SaintVenants principle - determination of displacements - bending of simple beams – Simple Supported and Cantilever Beam.

UNIT - III:

Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distributions Edge Dislocation - general solution of two-dimensional problem in polar coordinates - application to Plates with Circular Holes – Rotating Disk.

UNIT - IV:

Analysis of Stress and Strain in Three Dimensions: Analysis of stress and strain in three dimensions - principal stress - stress ellipsoid - director surface - determination of principal stresses Stress Invariants - max shear stresses Stress Tensor – Strain Tensor- Homogeneous deformation - principal axes of strain-rotation. General theorems: Differential equations of equilibrium - conditions of compatibility - determination of displacement - uniqueness of solution - reciprocal theorem Strain Energy.

UNIT - V:

Bending of Prismatic Bars: Stress function - bending of cantilever beam - beam of rectangular cross-section - beams of circular cross-section. Torsion of Circular Shafts - Torsion of Straight Prismatic Bars – Saint Venants Method - torsion of prismatic bars - bars with elliptical cross sections - membrane analogy - - solution of torsional problems by energy method - torsion of shafts, tubes , bars etc.Torsion of Rolled Profile Sections.

Text Books

1. S.P. Timoshenko & J.K Goodier , “Theory of Elasticity”, McGraw-Hill,3rd Edition.

2. “Applied Elasticity” by C.T. Wang.

Category: **Professional Elective Course** Subject Code**: 19ME3213**

Production Planning & Control

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Unit I

PPC performance

PPC – Requirements, Benefits, Factors influencing PPC performance, 3 types of decisions – 3 Phases of PPC – Aggregate and Disaggregate Planning – Master Production Schedule (MPS) – Techniques & Hour Glass Principle – Bill of Material (BOM) structuring

Unit II

MRP

Material Requirements Planning (MRP) System – Inputs, Outputs, Benefits, Technical issues – MRP system nervousness – Manufacturing Resources Planning (MRP II) – Resource Planning - Final assembly scheduling

Unit III

Capacity management

Capacity Planning using overall factors (CPOF) – Capacity Bills – Resource Profiles – Capacity requirements planning (CRP) – I/O Control - Shop floor control – Basic concepts, Gantt Chart, Priority sequencing rules and Finite Loading – Inventory models.

Unit IV

Shop floor control

Shop floor control – Just in time (JIT) – Key elements, techniques – JIT & PPC – Pull & Push Systems – Kanban system – Types, number of kanban calculations, Design, advantages and disadvantages

Unit V

ERP System

ERP systems – Components, Modules, Implementation, advantages and disadvantages - Technical aspects of SAP - Supply Chain Management (SCM) – Components, stages, Decision phases – Supply chain macro processes in a firm

Text Books

1. Vollmann, T.E., Berry, W.L., Whybark, D.C., and Jacobs, F.R., (2005), 'Manufacturing Planning and Control for Supply Chain Management' (5th ed.), Irwin.

Reference Books

1. Curran, T. and Keller, G.,(2009), 'SAP R/3 Business Blueprint' Prentice-Hall.

2. Sipper, D., Bulfin, R.L., (2007), 'Production Planning, Control, and Integration, McGraw Hill.

3. S.K. Mukhopadhyay (2009), Production planning and control – Text and Cases, PHI Ltd

Category: **Professional Elective Course** Subject Code**: 19ME3214**

Advanced Fluid Mechanics

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT- I

Inviscid flow of incompressible fluids: Lagrangian and Eulerain Descriptions of fluid motion- Path lines, Stream lines, Streak lines, stream tubes – velocity of a fluid particle, types of flows, Equations of three dimensional continuity equation- Stream and Velocity potential functions.

Basic Laws of fluid Flow: Condition for irrotationality, circulation & vorticity Accelerations in Cartesystems normal and tangential accelerations, Euler's, Bernouli equations in 3D– Continuity and Momentum Equations

UNIT- II

Viscous Flow: Derivation of Navier-Stoke's Equations for viscous compressible flow – Exact solutions to certain simple cases : Plain Poisoulle flow - Coutte flow with and without pressure gradient – Hagen Poisoulle flow - Blasius solution.

UNIT- III

Boundary Layer Concepts : Prandtl's contribution to real fluid flows – Prandtl's boundary layer theory - Boundary layer thickness for flow over a flat plate – Approximate solutions – Creeping motion (Stokes) – Oseen's approximation - Von-Karman momentum integral equation for laminar boundary layer — Expressions for local and mean drag coefficients for different velocity profiles.

UNIT- IV

Introduction to Turbulent Flow: Fundamental concept of turbulence – Time Averaged Equations – Boundary Layer Equations - Prandtl Mixing Length Model - Universal Velocity Distribution Law: Van Driest Model –Approximate solutions for drag coefficients – More Refined Turbulence Models – k-epsilon model - boundary layer separation and form drag – Karman Vortex Trail, Boundary layer control, lift on circular cylinders

Internal Flow: Smooth and rough boundaries – Equations for Velocity Distribution and frictional Resistance in smooth rough Pipes – Roughness of Commercial Pipes – Moody's diagram.

UNIT- V

Compressible Fluid Flow – I: Thermodynamic basics – Equations of continuity, Momentum and Energy - Acoustic Velocity Derivation of Equation for Mach Number – Flow Regimes – Mach Angle – Mach Cone – Stagnation State

Compressible Fluid Flow – II: Area Variation, Property Relationships in terms of Mach number, Nozzles, Diffusers – Fanno and Releigh Lines, Property Relations – Isothermal Flow in Long Ducts – Normal Compressible Shock, Oblique Shock: Expansion and Compressible Shocks – Supersonic Wave Drag.

TEXT BOOKS:

1.Fluid Mechanics / L.Victor Steeter / TMH

2.Fluid Mechanics / Frank M.White / MGH

Category: **Professional Elective Course** Subject Code**: 19ME3216**

Micro and Nano Machining

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Unit I :

Introduction to Micro Nano Machining

Need-evolution- fundamentals and trends in micro and nano technologies-Consequences of the technology and society-challenges to manufacturing technology-evolution of precision in manufacturing, tooling and current scenario- Micro Nano materials, fabrication tools, requirements and applications

Unit II :

Traditional Micro Nano machining

Theory of micromachining – Chip formation – Size effect in micromachining – microturning-micromilling, microdrilling - Micromachining tool design – Precision Grinding – Partial ductile mode grinding – Ultraprecision grinding

Unit III :

Advanced Micro Nano machining

Introduction-Classification- Mechanical Micromachining (AJM, USM)- Thermal Micromachining (EDM, LBM, EBM)-Electrochemical and Chemical Micromachining, Ion Beam Machining, Photochemical Etching

Unit IV :

Abrasive based Micro Nano machining

Abrasive Flow Finishing (AFF), Magnetic Abrasive Finishing (MAF), Magnetorheological Finishing, Magnetorheological Abrasive Flow Finishing, Elastic Emission Machining (EEM) and Magnetic Float Polishing

Unit V :

MEMS

Introduction to MEMS, Definitions and classifications-History-applications-MEMS Market- Bulk Micromachining- Wet and Dry Etching-Surface Micromachining-Chemical-Vapor Deposition-Lithography-Wafer Bonding

Text Books : V.K.Jain, Introduction to Micromachining, Narosa publishing House, New Delhi

Category: **Professional Elective Course** Subject Code**: 19ME3217**

Computational Fluid Dynamics

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT I

Introduction: Methods to solve a physical problem , numerical methods , brief comparison between FDM, FEM & FVM, applied numerical methods. Solution of a system of simultaneous linear algebraic equations, Iterative schemes of matrix inversion, direct methods for matrix inversion, direct methods for baned matrices. Finite difference applications in heat conduction and convention, heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer.

UNIT II

Finite differences: Discretization, consistency, stability, and fundamentals of fluid flow modeling. Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

UNIT III

Errors and stability analysis: introduction, first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme. Review of equations governing fluid flow and heat transfer: Introduction, Conservation of mass Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier stokes equations.

UNIT IV

Steady flow: Dimensions form of momentum and energy equations, navier stokes equation, and conservative body force fields, stream function, vorticity formulation, boundary, layer theory, buoyancy, driven convection and stability.

UNIT V

Simple cfd techniques: Viscous flows conservation form space marching, relovation techniques, viscous flows, conservation from space marching relovation techniques, artificial viscosity, the alternating direction implicit techniques, pressure correction technique, computer graphic techniques used in CFD. Quasi one dimensional flow through a nozzle, turbulence models, standard and high reynolds number models and their applications.

Text Books:

1. Computational Fluid Dynamics, J Chung (2010), 2nd edition, Cambridge University Press, India.

2. Computational Fluid Dynamics, John .D. Anderson (2010), 3rd edition, McGraw- Hill, India.

Category: **Professional Elective Course** Subject Code**: 19ME4111**

Refrigeration and Air Conditioning

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT I :

REFRIGERATION SYSTEM

Introduction to Refrigeration system : Necessity and applications – Unit of refrigeration and C.O.P. Mechanical Refrigeration – Types of Ideal cycles of refrigeration. Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system problems Refrigeration needs of Air crafts.

UNIT II :

VAPOUR COMPRESSION AND ABSORPTION REFRIGERATION

Vapour compression refrigeration – working principle and essential components of the plant simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p h charts effect of sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – numerical Problems

Vapor Absorption System – Calculation of max COP – description and working of NH3 water system and Li Br –water (Two shell & Four shell) System. Principle of operation Three Fluid absorption system, silent features

UNIT III:

SYSTEM COMPONENTS

System Components : Compressors – General classification – comparison – Advantages and Disadvantages. Condensers classification Working Principles Evaporators classification Working Principles Expansion devices Types Working Principles Refrigerants – Desirable properties – classification refrigerants used – Nomenclature – Ozone Depletion Global Warming

UNIT IV :

AIR CONDITIONING

Introduction to Air Conditioning Review of fundamental properties of psychometric – use of sychometric charts – psychometric processes – Grand and Room Sensible Heat Factors – by pass factor – requirements of comfort air conditioning –factors governing optimum effective temperature, recommended design conditions and ventilation standards. Concept of ESHF and ADP Requirements of human comfort and concept of effective temperature- Comfort chart –Comfort Air conditioning – Requirements of Industrial air conditioning, Air conditioning Load Calculations.

UNIT V:

AIR CONDITIONING SYSTEMS AND HEAT PUMP

Air Conditioning systems - Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, fans and blowers. Heat Pump – Heat sources – different heat pump circuits, air conditioning applications

TEXT BOOKS:

1. Arora C. P., Refrigeration and Air Conditioning, Tata McGraw Hill.2010
2. Ballany P.L., Refrigeration and Air Conditioning, Khanna Publications,2009

REFERENCE BOOKS:

1. Domkundwar, Refrigeration and Air Conditioning, Dhanpat Rai,2010
2. Ashrae Hand Book', 4 Vol., Current Ed., Carrier Air Conditioning Co., 'Hand Book of Air Conditioning', Prentice Hall of India, 1982
3. Basic Refrigeration and Air Conditioning**,** Tata McGraw-Hill Education, Apr-2005.

Category: **Professional Elective Course** Subject Code**: 19ME4112**

Tribology

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT I

Surfaces and friction: Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction - Adhesion Ploughint- Energy dissipation mechanisms Friction Characteristics of metals - Friction of non metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction - Stick slip motion - Measurement of Friction.

UNIT II

Wear: Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear - Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture wear - Wear of Ceramics and Polymers - Wear Measurements.

UNIT III

Lubricants and lubrication types: Types, properties, Requirements of Lubricants - Testing methods - Hydrodynamic Lubrication - Elasto hydrodynamic lubrication- Boundary Lubrication, Mist lubrication, Requirements of lubrication, Solid Lubrication, Hydrostatic Lubrication.

UNIT IV

Film lubrication theory: Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings - Virtual Co-efficient of friction - The Somerfield diagram.

UNIT V

Surface engineering and materials for bearings: Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

Text Books:

1. I.M. Hutchings, Tribology, " Friction and Wear of Engineering Material ", Edward Arnold, London, 1992.

Reference Books:

1. T.A. Stolarski, " Tribology in Machine Design ", Industrial Press Inc., 1990.

2. Kenneth C Ludema, Friction, Wear, Lubrication: A textbook in Tribology, CRC Press,1996.

Category: **Professional Elective Course** Subject Code**: 19ME4113**

Mechanics of Sheet Metal Forming

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Description of Material properties: Tensile test, effect of properties on forming. Sheet deformation processes: Uni-axial tension, general sheet forming processes, yielding, flow rule, work hardening hypothesis, work of plastic deformation, isotropic and anisotropic yield functions, Bauschinger effect modeling, effective stress and strain. Sheet deformation in plane stress: strain distributions, strain diagram, deformation modes, effective stress-strain laws, principal tensions. Stamping analysis: 2-D and 3-D model of stamping, stretch and draw ratios in stamping. Load instability and tearing: uniaxial tension of perfect strip and imperfect strip, tensile instability in stretching continuous sheet. Sheet formability: Forming limit curve – concept and evaluation, formability tests, theoretical prediction, factors affecting FLC. Sheet bending: Variables in bending a continuous sheet, equilibrium conditions, material models, bending without tension, springback. Analysis of circular shells: equilibrium equations, Models for forming axisymmetric shells. Cylindrical deep drawing: Drawing the flange, cup height, redrawing cylindrical cups, wall ironing of deep drawn cups. Stretching circular shells: Analysis of bulging with fluid pressure, stretching over punch. Combined bending and tension of sheet. Governing differential equations for finite element formulation. Recent advances: Hydroforming, tailor welded blanks, friction stir welding of sheets.

Textbooks/References:

[1] Z. Marciniak, J. L. Duncan, S. J. Hu, Mechanics of sheet metal forming, Elsevier, Butterworth-Heinemann, 2002

Category: **Professional Elective Course** Subject Code**: 19ME4114**

Convective Heat and Mass Transfer

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Introduction to convection. Derivation of governing equations of momentum, energy and species transport, Order of magnitude analysis, Reynolds analogy. Convective heat transfer in external flows: Derivation of hydrodynamic and thermal boundary layer equations, Similarity solution techniques, Momentum and energy integral methods and their applications in flow over flat plates with low and high Prandtl number approximations. Introduction to turbulence, Reynolds averaging, Eddy viscosity and eddy thermal diffusivity, Laws of the wall Convection in internal flows: Concept of developing and fully developed flows. Thermally developing flows: Graetz problem. Concept of thermally fully developed flow and its consequences under constant wall flux and constant wall temperature conditions, Steady forced convection in Hagen Poiseuille flow, Plane Poiseuille flow, and Couette flow and analytical evaluation of Nusselt numbers in limiting cases. Free convection: Free convection boundary layer equations: order of magnitude analysis, similarity and series solutions, Concept of thermal stability and Rayleigh Benard convection. Concept of boiling heat transfer and regimes in pool boiling Condensation: Nusselt film condensation theory, drop wise condensation and condensation inside tubes, effects of non-condensables Deviations from continuum: wall slip and thermal creep, an introduction to convective transport in micro-scales Conjugate problems and moving boundary freezing and melting problems. An introduction to convective mass transfer in binary systems: analytical solutions to simple one-dimensional problems

Category: **Professional Elective Course** Subject Code**: 19ME4115**

Advanced Engineering Thermodynamics

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Review of laws of thermodynamics. Energy concepts for closed and open systems. Minimization of entropy generation principle and thermodynamic optimization. Exergy analysis of thermal systems and plants. Thermo-economic applications. Phase transition. Equations of state. Multi-component and multi-phase system. Reactive systems. Kinetic theory of gases. Distribution of molecular velocities and energy, transport properties of gases. Principles of irreversible thermodynamics and applications.

Category: **Professional Elective Course** Subject Code**: 19ME4116**

Theory of Combustion and Emissions

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 0 - 0 - 3**

Introductory concepts. Thermodynamics of reacting systems: conservation of mass and energy in a chemical reaction, adiabatic flame temperature, second law aspects of chemical reactions. Essentials of chemical Kinetics: molarity and order of chemical reaction, general equation for rate of reaction, equation of Arrhenius, activation energy. Theories of premixed laminar and turbulent flames; concepts ofignition, flame stabilization, extinction and quenching. Theories of gaseous diffusion flames; droplet and spray combustion: theories of atomization, spray combustion models, spray combustion characteristics and design of burners; mechanism and kinetics of coal combustion; fluidized bed combustion; flames related to industrial applications; Emissions from combustion: constituents and types of emission, mechanisms of hydrocarbon and particulate emissions, theories of soot and NOx formation. Control of emissions.

Category: **Professional Elective Course** Subject Code**: 19ME4117**

Mechanical Handling Systems and Equipments

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 0 - 0 - 3**

Introduction to various Mechanical Handling Systems and Equipment for handling unit load and bulk materials, namely Pulley blocks, Winches, Electric Hoists, EOT Cranes, Belt Conveyor, Bucket Elevator, Screw conveyor and Pneumatic Conveyor etc. Dynamic analysis, design procedures of their components, common mechanisms involved and their industrial applications. Programmable and Flexible load handling devices

Category: **Professional Elective Course** Subject Code**: 19ME4118**

Phase Transformation and Heat Treatment of Materials

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Introduction and classification of phase transformations. Diffusion in solids: phenomenological approach and atomistic approach. Nucleation and growth theories of vapour to liquid, liquid to solid, and solid to solid transformations; homogeneous and heterogeneous strain energy effect during nucleation; interface-controlled growth and diffusion controlled growth; overall transformation kinetics. Principles of solidification, evolution of microstructures in pure metals and alloys. Precipitation from solid solution: types of precipitation reactions, crystallographic description of precipitates, precipitation sequence and age hardening, spinoidal decomposition. Iron-carbon alloy system: iron-carbon diagram, nucleation and growth of pearlite, cooling of hypo-eutectoid, eutectoid, and hyper-eutectoid steels, development of microstructures in cast irons. Heat treatment of steels: TTT and CCT diagrams, bainitic transformation, martensitic transformation, hardenability, role of alloying elements in steels, conventional heat treatment of steels. Massive transformation. Order-disorder transformation. Phase transformations in and heat treatment of some common non-ferrous metals and alloys.

Text Books:

1. D. A. Porter and K. Easterling: Phase Transformation inMetals and Alloys, CRC Press, 2000.

2. George Krauss: Steels-Heat Treatmentand Processing Principles, ASM International, Materials Park, Ohio,1990

Category: **Professional Elective Course** Subject Code**: 19ME4119**

Technology of Surface Coating

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Influence of manufacturing processes on various surface properties of an engineering component; scope of surface engineering in augmentation of surface properties Different processes used in surface engineering surface coatings and surface modifications, application oriented surface engineering processes for 3Dsurface, powder like substrate, internal surface, mass production; surface engineering problems related to substrate characteristics. Evaluation of engineered properties control properties, response properties; surface geometry characterization techniques (conventional and recent trends); coating thickness measurements laboratory techniques and special techniques for accurate routine thickness measurements; adhesion measurement conventional methods and recent developments; Measurement of mechanical properties of engineered surface in nano scale; Evaluation of tribological characteristics of engineered surface in macro, micro and nano scale, simulation of actual application environment in tribometer.

Category: **Professional Elective Course** Subject Code**: 19ME4120**

Fatigue, Creep and Fracture

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Fatigue: Types of fatigue loading and failure, Fatigue test, endurance limit; Fatigue under combine stresses; Influence of stress concentration on fatigue strength, Notch Sensitivity, Factors influencing fatigue behaviour.

Creep: Creep-stress-time temperature relations, Mechanics of creep, Creep intension, bending, torsion, creep buckling, Members subjected to creep and combine stresses.

Fracture: Basic modes of fracture, Griffith theory of brittle fracture, Irwins theory of fracture in elastic-plastic materials, Theories of linear elastic fracture mechanics, stress intensity factors, fracture toughness testing.

4th Year Sem1

Category: **Professional Elective Course** Subject Code**: 19ME4211**

Welding Technology

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT-I

Introduction: Welding as compared with other fabrication processes, Importance and application of welding, classification of welding processes, Health & safety measures in welding. Welding Power Sources: Physics of welding Arc, Basic characteristics of power sources for various arc welding processes, Transformer, rectifier and generators.

Physics of Welding Arc: Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas on arc, isotherms of arcs and arc blow. Metal Transfer: Mechanism and types of metal transfer in various arc welding processes.

UNIT-II

Welding Processes: Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electrogas and Electroslag, Flux Cored Arc Welding, Resistance welding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding & Microwave welding.

UNIT-III

Heat Flow Welding: Calculation of peak temperature; Width of Heat Affected Zone (HAZ); cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention.

UNIT-IV

Repair & Maintenance Welding: Hardfacing, Cladding, Surfacing, Metallizing processes and Reclamation welding. Weldability: Effects of alloying elements on weld ability, welding of plain carbon steel, Cast Iron and aluminium. Micro & Macro structures in welding.

UNIT-V

Weld Design: Types of welds & joints, Joint Design, Welding Symbols, weld defects, Inspection/testing of welds.

Books and References:

1. Welding and Welding Technology, by- Richard L. Little, McGraw Hill Education.
2. Welding Principals and Practices, by- Edwars R. Bohnart, McGraw Hill Education.
3. Welding Engineering and Technology, by- R. S. Parmar, Khanna Publishsers.
4. Welding Handbooks (Vol. I & II).

Category: **Professional Elective Course** Subject Code**: 19ME4212**

Laser Applications in Manufacturing

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Main industrial lasers: He, Ne, CO2,Excimer, Nd:YAG, Diode, Fiber and Ultra, short pulse lasers and their outputbeam characteristics; laser beam delivery systems. Overview of Laser Industrial and Scientific Applications: Metrological applications, Holography, Laser Isotope Separation, Laser fusion. Laser processing fundamentals: Laser beam interaction with metal, semiconductor and insulator, Ultra, short laser pulse interaction, heat flow theory and metallurgical considerations. Laser Material Processing Applications: Laser Cutting and drilling: Process characteristics, material removal modes, practical performances Laser Welding: Process mechanisms like keyhole and plasma effect, operating characteristics and process variation Laser Surface modifications: Heat treatment, surface remelting, surface alloying and cladding, surface texturing, LCVD and LPVD Laser rapid manufacturing Laser metal forming: Mechanisms involved including thermal temperature gradient, buckling, upsetting. Laser peening: Fundamentals of Laser Shock Processing, Effects of various laser and process parameters, Mechanical effects and microstructure modification during laser shock processing. Theoretical modeling of laser material processing On-line Process monitoring and control: Laser and process parameters, and workpiece characteristics Economics of Laser Applications in Manufacturing Laser Safety: Laser safety standards and safety procedures

Category: **Professional Elective Course** Subject Code**: 19ME4214**

Experimental Stress Analysis

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT – I :

Introduction: Stress, strain, Plane stress and plane strain conditions, Compatibility conditions. Problems using plane stress and plane strain conditions, stress functions, mohrs circle for stress strain, Three-dimensional stress strain relations.

UNIT – II :

Strain Measurement and Recordings: Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain gauge circuits. Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.

UNIT – III :

Photo elasticity: Photo elasticity – Polariscope – Plane and circularly polarized light, Bright and dark field setups, Photo elastic materials – Isochromatic fringes – Isoclinics
Three dimensional Photo elasticity : Introduction, locking in model deformation, materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear- difference method in three dimensions, applications of the Frozen-stress method, the scattered-light method.

UNIT – IV :

Brittle coatings: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

UNIT – V :

Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, the displacement field approach to Moire-Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire- Fringes, experimental procedure and techniques.

TEXT BOOKS

- Theory of Elasticity by Timoshenke and Goodier Jr.
- Experimental stress analysis by Dally and Riley, Mc Graw-Hill.

Category: **Professional Elective Course** Subject Code**: 19ME4215**

Design Optimization

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Formulation of Optimization Problems; Analytical Methods of Optimization; Numerical Methods: Unconstrained optimization of one Variable; Unconstrained optimization of Many Variables; Constrained Optimization of Many Variables: Linear and Nonlinear Programming; General Design Applications.

List of open Electives

Sl. No	Subject Code	Subject	L-T-P	Credits
1.	19ME4121	Product Design and Development	3-0-0	3
2	19ME4122	Finite Element Analysis	3-0-0	3
3	19ME4123	Automobile Engineering	3-0-0	3
4	19ME4124	Rapid manufacturing Process	3-0-0	3
5	19ME4221	Fundementals of Mechatronics Systems	3-0-0	3
6	19ME4222	Alternative Sources of energy	3-0-0	3
7	19ME4223	Non Destructive Testing	3-0-0	3

Product Design For Manufacturing

Unit I

Introduction to Product design

Introduction to Product design: Asimow's Model - Product design practice in Industry - Strength consideration in product design - Design for stiffness and rigidity

Unit II

Principles and evaluation methods

Principles and evaluation methods of various aspects of Design for X (machining - sheet metal working - injection molding - environment - service and repair - etc.).

Unit III

Manufacturability requirements

Manufacturability requirements - Forging design - Pressed component design - Casting design - Die Casting and special castings.

Unit IV

Assembly and assembly process

Assembly and assembly process - principles of Design for assembly and applications (Boothroyd / Dewhurst Method – case studies using DFMA software.)

Unit V

Other supporting techniques

Other supporting techniques for new product development processes such as quality function deployment - and quality engineering and Taguchi Method.

Text Books

1. Boothroyd, G., (1999), Product Design for Manufacture and Assembly, Marcel Decker.

References

1. Bralla, J.G., (1999), Design for Manufacturability Handbook, McGraw-Hill.
2. A.K. Chitale, R.C. Gupta, (1997), Product Design and Manufacturing., Printice –Hall of India.
3. James G. Bralla, (1999), Hand Book of Product Design for Manufacturing, McGraw Hill Company.
4. Swift K.G., (1999), Knowledge based design for manufacture, Kogan Page Ltd.

Category: **Open Elective Course** Subject Code**: 19ME4122**

Finite Element Analysis

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT – I

Introduction to FEA, Types of analyses, Basics of statics and strength of materials

UNIT – II

Introduction to meshing, Stiffness matrix derivation and assembly for bar elements. Thin shell elements, solid elements, symmetric boundary conditions

UNIT – III

Special elements and special techniques, Connection of solid elements with beams and shells, mass, spring and damper elements

UNIT – IV

Weld, bolt, bearing and shrink fit simulation, material properties and boundary conditions, linear analysis, Dynamic analysis

UNIT – V

Thermal analysis, Basics of Computational fluid dynamics, fatigue analysis.Post-processing techniques,Experimental validation and Data acquisition.

TEXT BOOKS:

1. Practical Finite element Analysis, Finite To Infinite, Gokhale Nitin S
2. Finite Element Method, Cengage Learning, 5th edition, Daryl L. Logan.

REFERENCES:

1. "Finite Element Analysis Using Ansys 11.0" PHI, Paleti Srinivas, Sambana Krishna Chaitanya Datti Rajesh Kumar.
2. "Finite Element Method in Engineering", Elsevier, Singiresu S. RAO.
3. "An Introduction to Finite Element Method",TMH,3rd edition, J.N. Reddy.

Category: **Professional Elective Course** Subject Code**: 19ME4123**

Automobile Engineering

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT I

Introduction: Components of a Four Wheeler Automobile – Chassis and Body – Power Unit –Power Transmission – Rear Wheel Drive, Front Wheel Drive, Four Wheel Drive – Types of Automobile Engines, Engine Construction, Turbo Charging and Super Charging – Oil Filters, Oil Pumps – Crank Case Ventilation.

UNIT II

Emissions from Automobiles – Pollution Standards National and International – Pollution Control– Techniques – Multipoint Fuel Injection for SI Engines- Common Rail Diesel Injection, Emissions from Alternative Energy Sources– Hydrogen, Biomass, Alcohols, LPG, CNG - Their Merits And Demerits. Electrical System: Charging Circuit, Generator, Current – Voltage Regulator – Starting System, Bendix Drive, Mechanism of Solenoid Switch, Lighting Systems, Horn, Wiper, Fuel Gauge – Oil Pressure Gauge, Engine Température Indicator.

UNIT III

Transmission System: Clutches- Principle- Types: Cone Clutch, Single Plate Clutch, Multi Plate Clutch, Magnetic and Centrifugal Clutches, Fluid Fly Wheel – Gear Box- Types: Sliding Mesh, Constant Mesh, Synchromesh, Epi-Cyclic, Over Drive, Torque Converter. Propeller Shaft – Hotch – Kiss Drive, Torque Tube Drive, Universal Joint, Differential, Rear Axles.

UNIT IV

Steering System: Steering Geometry – Camber, Castor, King Pin Rake, Combined Angle Toe-In, Center Point Steering. Types Of Steering Mechanism – Ackerman Steering Mechanism, Davis Steering Mechanism, Steering Gears – Types, Steering Linkages.

UNIT V

Suspension System: Objects of Suspension Systems – Rigid Axle Suspension System, Torsion Bar, Shock Absorber, Independent Suspension System. Braking System: Mechanical Brake System, Hydraulic Brake System, Pneumatic and Vacuum Brake Systems.

Text Books:

1. Automotive Mechanics – Vol. 1 & Vol. 2, Kirpal Singh, Standard Publishers Distributors, 13th edition, 2013.

2. Automobile Engineering , William Crouse, TMH, 10th edition, 2006.

Reference Books: Automobile Engineering , R.K.Rajput,Laxmi Pub, 1st edition, 2013.

Category: **Professional Elective Course** Subject Code**: 19ME4124**

Rapid Manufacturing Technologies

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Unit I Introduction

Need - Development of RP systems – RP process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping- Rapid Tooling - Benefits- Applications.

Unit II Reverse Engineering and CAD Modeling

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

Unit III Liquid Based and Solid Based Rapid Prototyping Systems

Stereolithography (SLA): Apparatus: Principle, per-build process, part-building, post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. laminated object manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

Unit IV Powder Based Rapid Prototyping Systems

Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS- powder structures, modeling of SLS, materials, post processing, post curing, surface deviation and accuracy, Applications. Three dimensional printing - types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies.

Unit V Rapid Tooling

Direct tooling methods -Direct tooling using stereo lithography - SLS Rapid Steel - Copper Polyamide Tooling - Direct Metal Laser Sintering - Laminated Tooling - Laser Engineered Net Shaping (LENS) - Controlled Metal Build-up (CMB) – Prometal, Shape deposition manufacturing, Selective Laser melting, Electron beam melting.Indirect Tooling methods -RTV Silicone Rubber Molds – Epoxy tooling -

Vacuum Casting – RIM - Wax Injection Molding - Spin Casting - Cast Resin Tooling - Spray Metal Tooling - Sprayed Steel Rapid Solidification Process - Plaster Molds -Electroforming - Cast Aluminum and Zinc Kirksite Tooling - Investment Cast Tooling

Text Books

1. Noorani, R. (2006), Rapid Prototyping: Principles and Applications, John Wiley & Sons, Inc., New Jersey.
2. Ali K. Kamrani, Emad Abouel Nasr, (2006), Rapid Prototyping: Theory and Practice, Springer.

Reference Books

1. Hopkinson, N., Hague, R.J.M. and Dickens, P.M., Rapid Manufacturing and Industrial Revolution for the Digital Age, John Wiley and Sons Ltd, Chichester, 2005
2. Gibson, I., Software Solutions for Rapid Prototyping, Professional Engineering Publication Ltd., 2002.
3. Patri, K. V., and Weiyin, Ma, Rapid Prototyping - Laser-based and Other Technologies, Kluwer Academic Publishers, U.S.A., 2003.
4. Chua, C.K., Leong, K.F., Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley and Sons Inc., 2000.

Product Design For Manufacturing

Unit I

Introduction to Product design

Introduction to Product design: Asimow's Model - Product design practice in Industry - Strength consideration in product design - Design for stiffness and rigidity

Unit II

Principles and evaluation methods

Principles and evaluation methods of various aspects of Design for X (machining - sheet metal working - injection molding - environment - service and repair - etc.).

Unit III

Manufacturability requirements

Manufacturability requirements - Forging design - Pressed component design - Casting design - Die Casting and special castings.

Unit IV

Assembly and assembly process

Assembly and assembly process - principles of Design for assembly and applications (Boothroyd / Dewhurst Method – case studies using DFMA software.)

Unit V

Other supporting techniques

Other supporting techniques for new product development processes such as quality function deployment - and quality engineering and Taguchi Method.

Text Books

1. Boothroyd, G., (1999), Product Design for Manufacture and Assembly, Marcel Decker.

References

1. Bralla, J.G., (1999), Design for Manufacturability Handbook, McGraw-Hill.
2. A.K. Chitale, R.C. Gupta, (1997), Product Design and Manufacturing., Printice –Hall of India.
3. James G. Bralla, (1999), Hand Book of Product Design for Manufacturing, McGraw Hill Company.
4. Swift K.G., (1999), Knowledge based design for manufacture, Kogan Page Ltd.

Category: **Open Elective Course** Subject Code**: 19ME4221**

Fundamentals of Mechatronics Systems

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 0 - 0 - 3**

Unit I

Introduction to Mechatronics

Introduction to Mechatronics – Conventional and Mechatronics approach in designing products - Mechatronics design process - Mechatronics in Manufacturing – Adoptive and distributed control systems – Modeling and simulation of mechatronics systems.

Unit II

Sensors and actuators

Overview of sensors and transducers – Microsensors - Signal conditioning – Operational amplifiers – Protection – Filtering - Analog and Digital converters. Electro – pneumatics and Electro – hydraulics - Solenoids – Direct Current motors – Servomotors – Stepper motors - Micro actuators; Drives selection and application.

Unit III

Microprocessor based Controllers

Architecture of microprocessor and microcontroller – System interfacing for a sensor, keyboard, display and motors - Application cases for temperature control, warning and process control systems.

Unit IV

Programmable Logic Controllers

Architecture of Programmable Logic Controllers – Input/Output modules – programming methods – Timers and counters – Master control – Branching – Data handling – Analog input/output – Selection of PLC and troubleshooting.

Unit V

Intelligent Mechatronics and Case Studies

Fuzzy logic control and Artificial Neural Networks in mechatronics – Algorithms – Computer – based instrumentation - Real-time Data Acquisition and Control – Software integration - Man-Machine interface -Vision system – Mechatronics system case studies.

Text Books

1. Bolton .W, (2008), Mechatronics, 4rd Edition, Pearson Education.

References:

1. DevdasShetty, Richard A. Kolk (2011), “Mechatronics System Design”, PWS Publishing Company.

2. Dan Necsulescu, (2002), “Mechatronics”, 3rd Edition, Pearson Education.

3. Michael B. Histand and David G. Alciatore (2005), “Introduction to Mechatronics and Measurement systems”, McGraw-Hill.

4. B.P. Singh (2002), “Advanced Microprocessor and Microcontrollers”, New Age International Publisher.

Category: **Open Elective Course** Subject Code**: 19ME4223**

Non-Destructive Evaluation and Testing

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

Unit I Introduction to NDET and Surface NDT Techniques

Introduction to non-destructive testing and evaluation, visual examination, liquid penetrant testing and magnetic particle testing. Advantages and limitations of each of these techniques.

Unit II Radiographic Testing

Radiography principle, electromagnetic radiation sources, X-ray films, exposure, penetrameter, radiographic imaging, inspection standards and techniques, neutron radiography. Radiography applications, limitations and safety.

Unit III Eddy Current Testing and Ultrasonic Testing

Eddy current principle, depth of penetration, eddy current response, eddy current instrumentation, probe configuration, applications and limitations. Properties of sound beam, ultrasonic transducers, inspection methods, flaw characterization technique, immersion testing.

Unit IV Special/Emerging Techniques

Leak testing, Acoustic Emission testing, Holography, Thermography, Magnetic Resonance Imaging, Magnetic Barkhausen Effect. In-situ metallography.

Unit V Defects in materials / products and Selection of NDET Methods

Study of defects in castings, weldments, forgings, rolled products etc. and defects arising during service. Selection of NDET methods to evaluate them. Standards and codes.

Text Books

1. Baldevraj, Jayakumar T., Thavasimuthu M., (2008) "Practical Non-Destructive Testing", 3rd edition, Narosa Publishers.

Reference Books

1. American Society for Metals, "Non-Destructive Evaluation and Quality Control": Metals Hand Book: 1992, Vol. 17, 9th Ed, Metals Park, OH.
2. Paul E Mix, "Introduction to nondestructive testing: a training guide", Wiley, 2nd edition New Jersey, 2005.

3. Ravi Prakash, “Nondestructive Testing Techniques”, New Age International Publishers, 1st rev. edition, 2010.

Category: **Open Elective Course** Subject Code**:**

Non-Conventional Sources of Energy

Internals: 40 Marks **L - T - P - C**

Externals: 60 Marks **3 - 0 - 0 - 3**

UNIT - I:

Introduction

Energy sources and their availability- commercial and non commercial energy sources. Need of Renewable Energy Sources (RES), classification of RES, Role and potential of RES in India. Solar Radiation: Structure of the sun, Solar constant, environmental impact of solar radiation, Radiation at the earth surfaces, solar radiation Geometry, extraterrestrial and terrestrial solar radiation, Spectral Distribution of Extraterrestrial Radiation, solar radiation on tilted surfaces and Empirical equations for predicting the availability of solar radiation at any given location. Solar energy - Thermal applications.

UNIT - II:

Solar Collectors

Principle of solar energy conversion into heat, classification of solar collectors, Flat plate collectors, basic energy balance equation, collector efficiency, thermal analysis of flat plate collector. Concentrating collectors and its advantages and disadvantages. Performance analysis of concentrating collectors, selection of absorber coating materials

UNIT - III:

Solar Energy Storage and Applications

Solar Energy Storage: Different storage methods- sensible, latent heat and stratified storage, solar ponds. Solar Energy Applications: Solar water, space heating /cooling, solar thermal electric conversion, direct solar electric power generation- solar photovoltaic, solar distillation, Solar Pumping, Solar furnace, Solar cocking and solar green house.

UNIT - IV:

Wind Energy, Biomass Energy Conversion Systems and Geothermal Thermal Energy

Wind Energy: Working principle of wind energy conversion, Wind patterns, Components of wind energy conversion system (WECS), Types of Wind machines – horizontal axis and vertical axis, Betz coefficient. Biomass Energy Conversion Systems: Biomass Energy: Fuel classification – Pyrolysis – Different digesters and sizing. Geothermal Thermal Energy: Classification – Dry rock and acquifer – Energy analysis

UNIT - V:

Ocean Thermal Energy, Tidal Power System and Wave Energy

Ocean Thermal Energy: Method s of Ocean Thermal Electric power generation-Open cycle systems, closed cycle systems Tidal Power System: Working principle, components of Tidal Power plant, single basin and double basin tidal energy system advantages and limitations . Wave Energy: Wave energy conversion Devices-wave energy conversion by floats, high level reservoir wave machine and dolphin type wave power machine. Advantages and disadvantages

UNIT - VI:

Direct Energy Conversion, MHDPower Generation and Fuel Cell

Direct Energy Conversion (DEC): Need for DEC, limitations, principles of DEC. Thermoelectric Power – See-beck, Peltier, Joule -Thomson effects, Thermo-electric Power generators MHD Power Generation: Principles, dissociation and ionization, Hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion. Fuel Cell: working principle, classification – Efficiency – VI characteristics.

Text Books

1. SP Sukhatme, “Solar Energy: Principles of thermal collection and storage” Tata McGraw Hill
2. Tiwari and Ghosal, “Renewable energy resources”, Narosa

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES BASAR

B. Tech
Chemical Engineering

Curriculum and Syllabus

A.Y. 2018-19

FIRST YEAR (E1)- SEMESTER I

S.NO.	Course Code	Course title	Category	Hours per week			Credits
				Lecture	Tutorial	Practical	
1	CH-MA1101	Mathematics-I	BS	3	1	0	4
2	CH-PH1101	Physics	BS	3	1	0	4
3	CH-CY1101	Chemistry -I	BS	3	1	0	4
4	BSBE1101	Biology	BS	3	0	0	3
5	HS1101	HASS-I Communicative English	HSMC	2	0	0	2
6	HS110x	HASS-II	HSMC	3	0	0	3
7	CH-PH1102	Physics lab	BS	0	0	3	1.5
8	CH-CY1102	Chemistry lab	BS	0	0	3	1.5
9	HS1102	Communicative English lab	HSMC	0	0	2	1
						TOTAL	24

HASS-II: 1. Education, Technology and Society
2. Values and Ethics

CH-MA1101 **MATHEMATICS – I**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **4-0-0**
Credits: 4

Course Objectives: To learn

- Types of matrices and their properties.
- Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- Concept of Eigen values and Eigen vectors and to reduce the quadratic form to canonical form.
- Concept of Sequence.
- Concept of nature of series.
- Geometrical approach to the mean values theorems and their application to the mathematical problems.
- Evaluation of surface areas and volumes of revolutions of curves.
- Evaluation of improper integrals using Beta and Gamma functions.
- Partial differentiation, concept of total derivative.
- Finding maxima and minima of function of two and three variables.

UNIT-I

Matrix Theory:

Types of Matrices, Symmetric, Hermitian, Skew-Symmetry, Skew-Hermitian, Orthogonal matrices, Unitary matrices; Elementary row and column operations on a matrix, Rank of a matrix by Echelon form and Normal form, Inverse of a Non-singular matrix by Gauss-Jordan method; Consistency and solutions of system of linear equations using elementary operations, Gauss elimination method; Gauss Seidel Iteration method.

UNIT-II

Eigen values and Eigen vectors:

Linear Transformation and Orthogonal Transformation; Characteristic roots and vectors of a matrix; Diagonalization of a matrix; Cayley-Hamilton theorem(without proof) ; finding inverse and power of a matrix by Caylay-Hamilton Theorem; Quadratic forms and Nature of the Quadratic forms; Reduction of quadratic form to canonical form by Orthogonal transformation.

UNIT-III

Sequences & Series:

Definition of a sequence, limit; Convergent, Divergent and Oscillatory sequences. Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test; Logarithmic test. Alternating series; Leibnitz test; Alternating Convergent series; Absolute and conditionally convergence.

UNIT-IV

Calculus:

Mean value theorems: Roll's theorem, Lagrange's Mean value theorem, Cauchy's Mean value theorem; Taylor's and Macaurin's series with remainders, Expansions; Applications of definite integrals to evaluate surface area and volumes of revolutions of curves (Only in Cartesian coordinates): Definition of Improper Integrals and their convergence, Beta and Gamma functions and their applications.

UNIT-V

Multivariable Calculus (Partial Differentiation and applications):

Definitions of Limits and continuity. Partial Differentiation; Euler's theorem; Total Derivative; Jacobian; Functional dependence and independence; Maxima and minima of functions of several variables (two and three variables) using Lagrange Multipliers.

Course outcomes: After learning the concepts of this paper the student must be able to

- Write the matrix representation of set of linear equations and to analyze the solution of the system of equations.
- Find the Eigen values and Eigen vectors.
- Reduce the quadratic form to canonical form using orthogonal transformations.
- Analyze the nature of sequence and series.
- Solve the applications on the mean value theorems.
- Evaluate the improper integrals using Beta and Gamma functions.
- Find the extreme values of functions of two variables with/without constraints.

TEXTBOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8th Edition,
2. R.K.Jain and S.R.K.Iyengar Advanced Engineering Mathematics, Narosa Publications House.2008
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

REFERENCES:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint,2002.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.
3. N.P. bail and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.

CH-PH1001 **PHYSICS**

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-1-0**
Credits: 4	

Course Objectives:

- To learn about crystallography, magnetic materials, super conductors, vacuum technology & Thin films and Nano materials.

Syllabus:

Unit – 1

Lasers: Characteristics of lasers – spontaneous and stimulated emission of radiation – Einstein's Coefficients – Population Inversion – Ruby laser- He-Ne laser- semiconductor laser Applications of lasers. Fiber optics: Introduction, propagation of light through optical fiber acceptance angle numerical aperture – types of optical fibers – refractive index profiles – fiber drawing process (Double crucible method) – applications of optical fibers.

Unit – 2

Quantum Mechanics: Black body radiation – Explanation using the photon concept – Photoelectric effect, Common effect, De- Broglie hypothesis, wave particle duality- Born interpretation of wave function – verification of matter waves- uncertainty principle, Schrodinger particle in a box, quantum harmonic oscillator.

Unit – 3

Magnetic materials: Classification of magnetic materials; dia, para, ferrow, anti ferrow and ferri magnetic materials, Weiss molecular field theory of ferromagnetism-magnetic domains- hysteresis curve- soft and hard magnetic materials –Ferrites-Applications of Ferrites.

Super conductivity: General properties of super conductors-Meissner effect-Type-1 and Type-2 super conductors-BCS theory (qualitative)-Introduction to High T_C super conductors- applications of super conductors.

Unit – 4

Thin films: Distinction between bulk and thin films-preparation of thin films by thermal deposition- RF sputtering – CVD process- Pulsed laser deposition-application of thin films- gas sensors, solar cells.

Nano materials: Introduction-properties of materials at reduce size- surface to volume ratio at Nano scale-classification of Nano materials- preparation of Nano materials: bottom – up method (Sol gel, CVD), Top-down method (Ball milling)- basic idea of carbon ions, application of Nano materials and their health hazards.

Unit – 5

Characterisation techniques: XRD technique, UV, Visible spectroscopic techniques, electron spin resonance spectroscopy, NMR spectroscopic techniques, IR and Raman spectroscopy, SEM and TEM spectroscopic techniques.

Course outcomes:

- To apply the concepts of crystallography, magnetic materials, super conductors, vacuum technology and thin films and Nano materials in various applications.

Text Books:

1. Arumugam. M, Material Science, Anuradha agencies publishers.

Reference books:

1. Bandopadhayay. A. K, Nano materials, new age International publications.
2. Goswamy. A, Thin films new age International publications.
3. Kittel.C, Introduction to solid state physics, Wiley Eastern Limited.
4. Tayal, D. C, Electricity and Magnetism.
5. Charatewrsiasation Technique by Cengage publications.
6. Loud,BB, Lasers and Nonlinear

CH-CY1101 **CHEMISTRY – 1**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 4

Course Objectives:

- To learn Chemical bonding, structural and reactivity aspects, qualitative analysis, volumetric analysis, gravimetric analysis, fuels and coordination compounds.

Syllabus:

Unit – 1:
Chemical Bonding: Introduction to molecular orbital theory. Linear combination of atomic orbitals (LCAO) method. Rule for Linear combination of atomic orbitals (LCAO), molecular orbital diagrams for simple diatomic molecules of H_2, N_2, O_2, O_2^- ion, F_2, NO and CO bond order.
Metallic bond: Properties of metals, theories of bonding in metals-valence bond theory. Explanation of metallic properties and its limitation, free electron theory, thermal and electrical conductivity of metals, limitations, band theory, formation of bands, explanation of conductors, semi-conductors and insulators. Formation of alloys, Hume-Rothery rules.

Unit – 2: Stereo Chemistry and Isomerism:
Structure isomerism: Chain, positional and functional isomerism-examples. Stereo isomerism: conformational isomerism-conformations of ethane and n-butane. Representation of Saw-horse formulae and Newman projection formulae. Configurational isomerism: Cis-Trans (E and Z) isomerism. Sequence rules for E and Z configurations. Optical isomerism: optical activity-plain polarized light, enantiomers, di-stereomers, meso structures and racemic mixtures. Plain of symmetry- examples. Asymmetry or chirality. Relative (D&L) configurations and absolute (R&S) configurations, sequence rules for assigning R and configurations. Examples – Glyceraldehyde, alanine, lactic acid 2-butanol. Isomerism in cyclo alkanes: configurational (cis-trans) isomers. Stability of rings in cyclo alkanes- Bayer's strain theory, Sachse-Mohr Theory, Puckered rings and conformational isomers of cyclo alkanes-conformations of cyclo hexanes, axial and equatorial bonds in cyclo hexane.

Unit – 3: Reactive intermediates and molecular rearrangements:
Reactive intermediates: generation, stability of reactions of carbocations, carbanions, carbines, nitrenes and free radicals.
Molecular rearrangements: Definition and Classification. Molecular rearrangement involving 1) Electron deficient carbon: Wagner-Meerwein, Pinacol-Pinacolone. 2) Electron deficient nitrogen: Hofmann, Schmidt and Beckmann rearrangements 3) Electron deficient oxygen: Baeyer-Villiger oxidation. 4) Base catalyzed rearrangements: benzylic acid, Favourski rearrangement.

Unit – 4

Electrochemistry-I: Review of Faraday's Laws of electrolysis-their significance. Validity of Ohm's law, specific conductance (K), equivalent conductance (Λ), measurement of equivalent conductance. Variations of equivalent conductance with dilution. Equivalent conductance at infinite dilution. Ionic mobility and transport number. Hittorf's method of determination of transport numbers of ions. Kohlrausch's law of independent migration of ions and its application to determine: 1) Λ_O of weak electrolytes, 2) degree of dissociation of weak electrolytes, 3) ionic mobility, 4) solubility and solubility product of sparingly soluble salts, and 5) ionic product of water, conductometric titrations.

Unit – 5

Chemical Kinetics: Scope, terminology- rate, rate constant, rate law, order, molecularity and half life time of chemical reaction. Derivation of integrated form of rate equation of first, second, third and zero order reactions and examples. Derivation of time half change. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy (E_a). Theories of reaction rates-Collision and activated complex theories. Activation parameters ($\Delta G^{\pm}, \Delta S^{\pm}$ & $\Delta H^{\pm}$) determination.

Course Outcomes:

- To apply chemical bonding, structural and reactivity aspects, qualitative analysis, volumetric analysis, gravimetric analysis, fuels and coordination compounds.

Text Books:

1. Puri, Sharma&Kalia, principles of inorganic chemistry, Milestone publishers, Delhi, 33rd edition 2016.

Reference Books:

1. C.ParameswaraMurty, C.V.Agarwal&A.Naidu, Engineering Chemistry, B.S publications, Hyd, 2006.
2. J.D. Lee, Concise inorganic chemistry, ELBS publication, 3rd edition.
3. A.I. Vogel, Quantitative inorganic analysis, ELBS-4th edition, 1991.
4. Satyaprakash, Bahl&Tuli inorganic chemistry, Chand publishers, 8th edition, 2014.
5. Jain& Jain, Engineering Chemistry, Dhanpathrai publications, 1991

BSBE104 **BIOLOGY**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Course Objectives:

- Students will be introduced to the basics of biology such as cell structures and functions, inheritance & evolution, basic concepts of genetics, and an introduction to microbiology.

Syllabus:

Unit - 1
Basics: Diversity of life, prokaryotes and eukaryotes, basic cell constituents and macromolecules.

Unit - 2
Biochemistry: Metabolism (Catabolism and Anabolism) and Bioenergetics.

Unit - 3
Genetics: Basic principles of Mendel, molecular genetics, structure & function of genes and chromosomes, Transcription and Translation, gene expression and regulation.

Unit - 4
Cell Biology: Macromolecules, membranes, organelles, cytoskeleton, signaling, cell division, differentiation, motility.

Unit - 5
Microbiology: host- microbe interactions, physiology, ecology, diversity, and virology.

Course outcomes:

- Students will get insight into biology as a science, outlining the diversity, organization and fundamental principles of living systems.

Text Books:

Reference books:

HS1101 **COMMUNICATIVE ENGLISH (HASS-I)**

Externals: 60Marks **L-T-P**
Internals: 40Marks **2-0-0**
Credits: 2

Course Objectives: The course will help to

- Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
- Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
- Develop study skills and communication skills in formal and informal situations.

Syllabus:

Unit-1
'The Raman Effect' from the prescribed textbook 'English for Engineers' published by CambridgeUniversity Press.
Vocabulary Building: The Concept of Word Formation --The Use of Prefixes and Suffixes.
Grammar: Identifying Common Errors in Writing with Reference to Articles andPrepositions.
Reading: Reading and Its Importance- Techniques for Effective Reading.
Basic Writing Skills: Sentence Structures; Use of Phrases and Clauses in Sentences, Importance of Proper Punctuation, Techniques for writing precisely; **Paragraph writing**; Types,Structures and Features of a Paragraph, Creating Coherence Organizing Principles ofParagraphs in Documents.

Unit-2
'Ancient Architecture in India' from the prescribed textbook 'English for Engineers'published by Cambridge University Press.
Vocabulary: Synonyms and Antonyms.
Grammar: Identifying Common Errors in Writing with Reference to Noun-pronounAgreement And Subject-verb Agreement.
Reading: Improving Comprehension Skills – Techniques for Good Comprehension.
Writing: Format of a Formal Letter-**Writing Formal Letters** E.g.., Letter of Complaint,Letter of Requisition, Job Application with Resume.

Unit-3
'Blue Jeans' from the prescribed textbook 'English for Engineers' published byCambridge University Press.
Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English toform Derivatives-Words from Foreign Languages and their Use in English.
Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiersand Tenses.
Reading: Sub-skills of Reading- Skimming and Scanning

Writing: Nature and Style of Sensible Writing- **Defining- Describing** Objects, Places andEvents – **Classifying**- Providing Examples or Evidence

Unit-4

'What Should You Be Eating' from the prescribed textbook 'English for Engineers'published by Cambridge University Press.

Vocabulary: Standard Abbreviations in English.

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Comprehension**-** Intensive Reading and Extensive Reading.

Writing: Writing Practices**;**Writing Introduction and Conclusion, Essay Writing; Précis Writing.

Unit-5

'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'Englishfor Engineers' published by Cambridge University Press.

Vocabulary: Technical Vocabulary and their usage

Grammar: Common Errors in English

Reading: Reading Comprehension-Exercises for Practice

Writing: Technical Reports- Introduction – Characteristics of a Report – Categories ofReports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Course Outcomes:

Students should be able to

- Use English Language effectively in spoken and written forms.
- Comprehend the given texts and respond appropriately.
- Communicate confidently in various contexts and different cultures.
- Acquire basic proficiency in English including reading and listening comprehension,writing and speaking skills.

Textbooks:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

References Books:

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P. (2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007).Remedial English Grammar. Macmillan.
4. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
5. Hamp-Lyons, L. (2006).Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford UniversityPress.

HS110x **EDUCATION, TECHNOLOGY AND SOCIETY**

(HASS-II)

Externals: 60Marks	**L-T-P**
Internals: 40Marks	**2-0-0**
Credits: 2	

Course Objectives:

The goal of the proposed course is to enable students:

- To explore the various ways in which technology has and may in future affect not only the mode of delivery of education but also the very nature of education.
- To understand the requirement of education: a. for becoming an effective member of the society b. to fulfill the potential of a learner to the fullest without too much thought of an individual's responsibility towards the contemporary society.

Syllabus:

Unit-1

Necessity of education for human life, Impact of education on society.

Unit-2

Nature and scope of education (Gurukul to ICT driven), Emotional intelligence, Domains of learning, Approaches to learning, Learning outcomes.

Unit-3

Role of education in technology advancement.

Unit-4

Technology and society; management of technology; technology transfer.

Unit-5

Ethical and value implications of education and technology on individual and society.

Course Outcomes:

On successful completion of this course, the students will be able to integrate their technical education for betterment of society as well motivates them to lead a good human life.

Reference Books:

- Education and Social order by Bertrand Russel
- Theories of learning by Bower and Hilgard
- Technology and Society by Jan L Harrington

HS110x **VALUES AND ETHICS**

(HASS-II)

Externals: 60Marks **L-T-P**
Internals: 40Marks **2-0-0**
Credits: 2

Syllabus:

Unit-1
Definition and classification of values: Extrinsic values, Universal and Situational values, Physical, Environmental, Sensuous, Economic, Social, Aesthetic, Moral and Religious values.

Unit-2
Concepts related to values: Purusartha, Virtue, Right, duty, justice, Equality, Love and Good.

Unit-3
Egoism, Altruism and universalism. The Ideal of Sarvodaya and Vasudhaiva Kutumbakam.

Unit-4
The Problem of Sustenance of value in the process of Social, Political and Technological changes.

Unit-5
The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi.

Text books:

- डॉ ि नानंदिम : नी ि तशा (Motilal Banarasidas, 2005)
- डॉवेदकाशवमा : नी ि तशाके मूलिसांत, (Allied Publication, Delhi, 1977)
- डॉसंगमलालपांडे : नी ि तशाकासवण (सटलपिशंगहादस, इलाहाबाद-2005)
- Little, William, : An Introduction of Ethics (allied Publisher, Indian Reprint 1955)
- William, K Frankena : Ethics (Prentice Hall of India, 1988)
- Dr. Awadesh Pradhan : Mahamana ke Vichara. (B.H.U., Vanarasi-2007)

CH-PH1102 **PHYSICS LAB**

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**0-0-3**
Credits: 1.5	

Course objectives:

- To practice the study of dielectric properties, BH curve, PN Junction diode and solar cells.

Syllabus:

1. Determination of Dielectric Constant and Phase transition temperature of PZT material.
2. To trace the BH-curve (Hysteresis) of Ferromagnetic specimen using CRO and Measurement of area of BH loop, evaluate energy loss in the specimen.
3. Determination of carrier concentration, mobility and Hall Coefficient of Ge crystal using Hall Effect experiment.
4. To draw the I-V characteristic of Solar cell and to calculate i) Fill factor , ii) Efficiency, iii) Series resistance of the solar cell.
5. To determine the lande g factor (spectroscopic splitting factor) using Electron Spin Resonance spectrometer for the DPPH sample.
6. To determine Plank's Constant and work function of photo metal.
7. To determine Temperature Characteristics of Thermistor and to find the constants.
8. Determination of the numerical aperture and acceptance angle of the given optical fiber optics.
9. Determination of wavelength of Laser source by using Diffraction grating.
10. To find the values of electrical conductivity and energy gap of Ge crystal by Four Probe method.

Course Outcomes:

- Students will be able to use the materials of dielectric, BH curve, PN Junction diode and solar cells.

CH-CY1102 **CHEMISTRY LAB**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **0-0-3**
Credits: 1.5

Course Objectives:

- About 10-12 experiments to illustrate the concepts learnt in the theory

Syllabus:

1. **Volumetry**
   i. Determination of carbonate and bicarbonate in a mixture
   ii. Determination of Fe(II) using $KMnO_4$ with oxalic acid as primary standard
   iii. Determination of hardness of water
2. **Synthesis of Organic compounds**
   i. M-dinitrobenzene
   ii. Aspirin
   iii. Preparation of benzoic acid from benzoyl chloride
   iv. Preparation of benzilidine aniline
3. **Identification of organic compounds through group detection**
4. **Distribution law**
   i. Determination of molecular state of acetic acid by studying the distribution of acetic acid between n –butanol and water.
   ii. Determination of molecular state of benzoic acid by studying the distribution of benzoic acid between benzene and water.
5. **Chemical Kinetics**
   i. Determination of order of the reaction of hydrolysis of methyl acetate in dilute hydrochloric acid.
   ii. Determination of order of the reaction between potassium phosphate and potassium iodide.
6. **Electrochemistry**
   i. Determination of concentration of HClconductometrically using standard NaOH solution.
   ii. Determination of concentration of acetic acid conductometrically using standard NaOH solution.
   iii. Potentiometric reduction titration of Fe+2 and $K_2Cr_2O_7$.
   iv. Titration of HCl against NaOH using pH meter.
7. **Colorimetry**
   i. Verification of Beer-Lambert law
   ii. Determination of concentration of the given $K_2Cr_2O_7$or $KMnO_4$ solution

HS1102 COMMUNICATIVE ENGLISH LANGUAGE LAB

Orals (Written): 50Marks **L-T-P**
Written (Externals): 50Marks **0-0-2**
Credits: 1

Course Objectives:

- To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
- To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm.
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize their mother tongue influence
- To train students to use language appropriately for public speaking and interviews

Syllabus
Listening Skills:
Objectives:

- To enable students develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation.
- To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions *Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.*
- Listening for general content
- Listening to fill up information
- Intensive listening for specific information

Speaking Skills:
Objectives:

- To involve students in speaking activities in various contexts
- To enable students express themselves fluently and appropriately in social and professional contexts
- Oral practice: Just A Minute (JAM) Sessions Describing objects/situations/people
- Role play – Individual/Group activities

Course Outcomes:
Students will be able to attain

- Better understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills.

FIRST YEAR (E1)- SEMESTER II

S.NO.	Code	Course title	Category	Hours per week			Credits
				Lecture	Tutorial	Practical	
1	CH-MA1201	Mathematics-II	BS	3	1	0	4
2	CH-CY1201	Chemistry-II	BS	3	1	0	4
3	CH1201	Engineering Thermodynamics	ESC	3	1	0	4
4	CH-ME1201	Engineering and Solid Mechanics	ESC	3	0	0	3
5	CS1201	Programming for problem solving	ESC	3	0	0	3
6	CE1201	Engineering Graphics	ESC	1	0	2	2
7	ME1201	Engineering Workshop	ESC	0	0	3	1.5
8	CS1202	Programming for problem solving lab	ESC	0	0	3	1.5
						TOTAL	23

CH-MA1201 **MATHEMATICS – II**

Externals: 60 Marks **L-T-P**
Internals : 40 Marks **4-0-0**
Credits: 4

Course Objectives:

- Methods of solving the differential equations of first and higher order.
- To study the methods of solving improper integrals and the concepts of multiple integrals
- The basic properties of vector valued functions and their applications to line, surface and volume integrals
- To Introduce Functions of Complex variables, Power series, Bilinear Transformations & Conformal Mapping.

Syllabus:

Unit-1
Ordinary Differential Equations of first order: Exact first order differential equation, finding integrating factors, linear differential equations, Bernoulli's , Riccati , Clairaut's differential equations, finding orthogonal trajectory of family of curves, Newton's Law of Cooling, Law of Natural growth or decay.

Unit-2
Ordinary Differential Equations of higher order:
Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type $e^{ax}, \sin(ax), \cos(ax)$, polynomials in $x, e^{ax}V(x), xV(x)$; method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

Unit-3
Integral Calculus:
Evaluation of the double integrals (Cartesian and Polar), change of order of integration (only Cartesian form), Evaluation of Triple integrals.Change of variables (Cartesian to polar) in case of double integrals (Cartesian to spherical and cylindrical) in case of Triple Integrals-Jacobians of transformations.Differentiation of integrals with variable limits - Leibnitz rule.
Applications: Finding Areas (using double integrals) and volumes (using double and Triple Integrals), Centre of mass, Centre of gravity for constant and variable densities by double and triple integrals (applications involving cubes, Sphere and rectangular parallelepiped)

Unit-4

Vector Differentiation: Vector point functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal line. Vector Identities. Scalar potential functions. Solenoidal and Irrotational vectors. **Vector Integration:** Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

Unit-5

Functions of Complex Variables: Limits and continuity of function, differentiability and analyticity, necessary and sufficient condition for function to be analytic, Cauchy Riemann Equations in polar form, Harmonic functions.

Complex Integration: Definition, Cauchy's integral theorem for multiple connected regions, Cauchy's integral formula, Cauchy's formula for derivatives and their applications

Course Outcomes:

At the end of the course student will be able to

- Solve first order linear differential equations and special non linear first order equations like Bernouli , Riccati&Clairaut's equations
- Compute double integrals over rectangles and type I and II" regions in the plane
- Explain the concept of a vector field and make sketches of simple vector fields in the plane.
- Explain concept of a conservative vector field, state and apply theorems that give necessary and sufficient conditions for when a vector field is conservative, and describe applications to physics.
- Recognize the statements of Stokes' Theorem and the Divergence Theorem and understand how they are generalizations of the Fundamental Theorem of Calculus.
- Able to solve the problems in diverse fields in engineering science using numerical methods.

Text Books:

1.Advanced Engineering Mathematics (3rd Edition) by R. K. Jain and S. R. K. Iyengar, Narosa Publishing House, New Delhi

References Books

1. Advanced Engineering Mathematics (8th Edition) by Erwin Kreyszig, Wiley-India.

2. Dr. M.D. Raisinghania,Ordinary andPartialdifferentialequations,S.CHAND,17th Edition2014.

CH-CY1201 **CHEMISTRY – II**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 4

Course Objectives:

- Students will be able to learn Coordination Compounds, Fuels, electrochemistry, spectroscopy and Catalysis.

Syllabus:

Unit – 1
Coordination Compounds: Double salts and Coordination Compounds, Werner's Theory, EAN rule, Nomenclature, theories of metal ligand bonding, valence bond theory, crystal field theory, splitting of 'd' orbital in octahedral, tetrahedral and square planar complexes in qualitative analysis.

Unit – 2
Fuels: Classification of fuels, properties of fuels, Solid fuels: Coal, analysis of coal; proximate analysis, ultimate analysis, Carbonization of Coal by low temperature and high temperature. Liquid fuels: Characterization of liquid fuels, Petroleum – Fractional distillation of crude petroleum, Octane numbers, Cetane number. Bio-fuels; preparation and advantages.
Gaseous fuels: Advantages of gaseous fuels, water gas, producer gas, LPG, combustion, calculation of air required for combustion, analysis of flue gases – Orsat Apparatus, calorific value: Gross calorific value, net calorific value.

Unit – 3
Electrochemistry II: Origin of potential across electrode – electrolyte interface, standard electrode potential (E^o), Galvanic or electrochemical cells, Conventional representation, measurement of cell emf. Reversible and irreversible cells, types of reversible electrodes. Thermodynamics of reversible cells, Nernst expression for cell emf. Hydrogen, calomel, quinhydrone and glass electrodes – pH determination potentiometric titrations. Classification of electrochemical cells – chemical and concentration cells with and without transference - representation of each type & expressions for cell emf without derivatives.

Unit – 4
Molecular Spectroscopy
Electronic spectroscopy:
Interaction of electromagnetic radiation types of molecular spectra. Energy levels of molecules (σ,π, n). Selection rules for electronic spectra. Types of electronic transitions: $\sigma-\sigma^*$, $n-\sigma^*$, $\pi-\pi^*$, with suitable examples. Definitions of chromophore, auxochrome, bathochromic and hypsochromic shifts. Absorption of characteristic functional groups: C=C, C−C, C=O, NO_2, COOH. Meaning of extended conjugation and its effects on λmax.

Infrared spectroscopy:
Energy levels of simple harmonic oscillator, molecular vibration spectrum, specific rules. Determination of force constant. Qualitative relation of force constant to bond energies. Anharmonic motion of real molecules and energy levels. Modes of vibrations in polyatomic molecules. Characteristic absorption bands of various functional groups. Finger print structure of infrared spectrum.
Proton Magnetic resonance spectroscopy:
Principles of nuclear magnetic resonance, equivalent and non-equivalent protons. Position of signals. Chemical shift, NMR splitting of signals – spin –spin coupling. Applications of NMR with suitable examples – ethyl bromide, ethanol, acetaldehyde, 1,1,2 – tribromo ethane, ethyl acetate, toluene and acetophenone.

Unit – 5
Catalysis: Homogeneous and heterogeneous catalysis, comparison with examples. Kinetics of specific acid catalyzed reactions, inversion of cane sugar. Kinetics of specific base catalyzed reactions, base catalyzed conversion of acetone to diacetone alcohol. Acid and base catalyzed reactions – hydrolysis of esters, mutarotation of glucose. Catalytic activities at surfaces. Mechanism of heterogeneous catalysis. Langmuir – Hinshelwood mechanism.
Phase transfer catalysis (PTC): principles of phase transfer catalysis, PTC classification. Role of water in PTC reactions. Factors influencing the rate of PTC reactions. Inverse phase transfer catalysis.

Course Outcome:
- Students will be able to apply the concepts of Coordination compounds, fuels, electrochemistry, spectroscopy and catalysis.

Text book:
1. Organic chemistry by K.S. Mukherjee
2. Organic chemistry by T.W Graham solomons, Craig B. Fryhle, 9^{th} Ed., Wiley India Pvt Ltd, 2008.

Reference Books:
1. The fundamental principles of organic chemistry by I.L.Finas, ELBS London.
2. Organic reaction mechanisms by V.K>Ahluwalia & R.K. Parashar, Narosha Publishers, 4^{th} Ed., 2010.
3. Stereochemistry by P.S.Kalsi, New age International publishers, 2016.
4. Organic chemistry by L.G.Wade, Jr. Maya shaker singh, 4^{th} Ed., Amazon,2011

CH1201 ENGINEERING THERMODYNAMICS

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-1-0**
Credits: 4	

Course Objectives:

- To understand and apply the laws of thermodynamics
- To get familiar with various terminology of thermodynamics like system, properties, processes, reversibility, equilibrium, phases, components; the relationship between heat and work.
- To understand the various concepts on P-V-T behavior, Equations of state, thermodynamic diagrams and compressibility charts, entropy, irreversibility and problem solving skills.
- To understand various thermodynamic cycles.
- To learn about the various liquefaction and refrigeration processes and their working principle

Syllabus:

Unit-1

Scope and limitations of thermodynamics, definition and fundamental concepts, pressure, energy, work, heat. Equilibrium state. Zeroth law of thermodynamics. First law of Thermodynamics: General statement, thermodynamic state and state functions, Internal energy, Enthalpy.

The steady-state steady-flow process, Mass and energy balances, the reversible process, constant-V and constant- P processes, heat capacity, isobaric, isochoric, isothermal, adiabatic and polytrophic processes.

Unit-2

Volumetric properties of pure substances: The PVT behavior of pure substances, phase rule, virial equations, the ideal gas, the applications of the virial equations. Cubic equations of state, generalized correlations for gases, generalized correlations for liquids.

Unit-3

Heat effects: Sensible heat effects, Internal energy of ideal gases: Microscopic view, Latent heats of pure substances, heat effects of mixing processes. Standard heat of reaction, Standard heat of formation, Standard heat of combustion, temperature dependence of heat of reaction.

Unit-4

Second law of Thermodynamics-Statement, Heat engines, thermodynamic temperatures scales, thermodynamic temperature and the ideal gas scale. Entropy, Entropy changes of an ideal gas, mathematical statement of the second law, entropy from the microscopic view point, calculation of ideal work and lost work. Third law of Thermodynamics. Power Cycles-Carnot cycle, Rankine cycle.

Unit-5

Refrigeration and liquefaction: The Carnot refrigerator, the vapor compression cycle, the comparison of refrigeration cycles, the choice of refrigerant, absorption refrigeration, the heat pump, liquefaction processes.

Course Outcomes:

- A fundamental understanding of the first and second laws of thermodynamics and their application to a wide range of systems.
- Understanding of the first law of thermodynamics and various forms of work that can occur. An ability to analyze the work and heat interactions associated with a prescribed process path, and to perform a first law analysis of a flow system.
- An ability to evaluate entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations. Familiarity with calculations of the efficiencies of heat engines and other engineering devices.
- An understanding of the use of the Gibbs and Helmholtz free energies as equilibrium criteria, and the statement of the equilibrium condition for closed and open systems. An understanding of the interrelationship between thermodynamic functions and an ability to use such relationships to solve practical problems.
- Familiarity with the construction and principles governing the form of simple and complex one-component pressure-temperature diagrams and the use of volume-temperature and pressure-volume phase diagrams and the steam tables in the analysis of engineering devices and systems.
- Ability to determine the equilibrium states of a wide range of systems, ranging from mixtures of gases, mixtures of gases and pure condensed phases, and mixtures of gases, liquids, and solids that can each include multiple components.

Text Books:

1. Introduction to Chemical Engineering Thermodynamics, J M Smith, H C Van Ness and M Abbott, 6th Edition, TMH.

Reference Books:

1. A text book of Chemical Engineering Thermodynamics, K.V. Narayanan, PHI.
2. Engineering Thermodynamics, P.K Nag.
3. Chemical and Process Thermodynamics, B.G Kyle, PHI Pvt. Ltd.

CH-ME1201 **ENGINEERING AND SOLID MECHANICS**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Course Objectives:

- To learn Force systems, Analysis of structures, Friction and moment of inertia.

Syllabus:

Unit – 1
Force systems:resultant of coplanar concurrent forces, Components of force in space, Momentum of force and its applications, Couples and resultant of force systems.

Unit – 2
Equilibrium of Force systems: Free body diagram, Equations of equilibrium, Equilibrium of planar and spatial system.

Unit – 3
Analysis of Structures: Analysis of trusses by method of joints and method of sections, Analysis of frames by method of members.

Unit – 4
Friction: Laws of friction, application to simple systems. Connected systems and belt friction. Wedge friction.

Unit – 5
Centroid and momentum of inertia: Centroids of lines, areas and composite areas, momentum of inertia for areas, composite areas, polar momentum of inertia and radius of gyration.

Course Outcomes:

- To apply the basics of Force systems, Analysis of structures, Friction and momentum of inertia in designing of mechanics.

Text Books:

1. Ferdinand L. Singer, “Engineering Mechanics”, Harper & Collins, Singapore, 1975.
2. S.P. Timoshenko and D.H.Young, “Engineering Mechanics”, McGraw-Hill International Edition, 1983
3. S. Rajasekaram and G. Sankarasubrahmanyam, “Engineering Mechanics”, Vikas Publications, 2002
4. S.B. Junarkar and H.J. Shah, “Apllied Mechanics”, Charotar Publishers, 2001
5. I.H. Shames, “Engineering Mechanics”, Prentice Hall of India, 1987.

CS1201 **PROGRAMMING FOR PROBLEM SOLVING**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 3

Syllabus:

Unit-1
Introduction to Programming & Arithmetic expressions and precedence, Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). **Idea of Algorithm:** steps to solve logical and numerical problems. **Representation of Algorithm:** Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code. Arithmetic expressions and precedence.

Unit – 2
Conditional Branching, Loops & Arrays, Writing and evaluation of conditionals and consequent branching, Iteration and loops, Arrays (1-D, 2-D), Character arrays and Strings.

Unit – 3
Function & Basic Algorithms, Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference, Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Unit – 4
Recursion & Structure, Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort, Structures, Defining structures and Array of Structures

Unit – 5
Pointers & File handling, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation) File handling (only if time is available, otherwise should be done as part of the lab)

Text Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

References Books:
1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

CE1201 **ENGINEERING GRAPHICS**

Externals: 50 Marks **L-T-P**
Internals: 50 Marks **1-0-2**
Credits: 2

Course Objectives:

- To introduce the students to the "Universal Language of Engineers" for effective communication through drawing.
- To understand the basic concepts of drawing through modern techniques.
- To impart knowledge about standard principles of projection of objects.
- To provide the visual aspects of Engineering drawing using AutoCAD.

Syllabus:

Unit-1
Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, types of lines and Dimensioning.
Over view of AutoCAD: Theory of CAD software (The Menu System, Tool Bars, Drawing area, Dialogue boxes, Shortcut Menu, the command lines, Select and erase objects, Introduction to layers etc.), Drawing simple figures- lines, planes, solids.

Unit-2
Geometrical constructions: Construction of regular polygons.
Conic sections: Construction of Ellipse, Parabola, Hyperbola (General method only), Cycloid, Epicycloid, Hypocycloid and Involutes.
Scales: Construction of Plain, Diagonal and Vernier scales.

Unit-3
Orthographic projections: Principles of Orthographic Projections
Projections of Points: Projections of Points placed in different quadrants
Projection of lines: lines parallel and inclined to both the planes (Determination of true lengths and true inclinations and traces)
Projection of planes: Planes inclined to both the reference planes

Unit-4
Projection of Solids: Projection of solids whose axis is parallel to one of the reference planes and inclined to the other plane, axis inclined to both the planes
Projection of sectioned solids: Sectioning of simple solids like prism, pyramid, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

UNIT-5
Development of surfaces: .Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views of planes and simple solids
Perspective projections: Basic concepts of perspective views.

Course Outcomes: At the end of the course, the student will be able to

- Use Engineering principles and techniques to understand and interpret engineering drawings.
- Understand the concepts of AutoCAD.
- Draw orthographic projections of lines, planes and solids using AutoCAD.
- Use the techniques, skills and modern engineering tools necessary for engineering practices.

Text/Reference Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., Engineering Drawing, Charotar Publishing House,2014
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
3. Shah, M.B. &Rana B.C, Engineering Drawing and Computer Graphics, Pearson Education,2008
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age publications
5. Agrawal B. & Agrawal C. M., Engineering Graphics, TMH Publication 2012,
6. Narayana, K.L. & P Kannaiah, Text book on Engineering Drawing, Scitech Publishers, 2008
7. (Corresponding set of) CAD Software Theory and User Manuals

ME1201 **ENGINEERING WORKSHOP**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **0-0-3**
Credits: 1.5

Course Objectives:

- To understand the basic manufacturing process of producing a component by casting, forming plastic molding, joining processes, machining of a component either by conventional or by unconventional processes.
- To understand the advanced manufacturing process of additive manufacturing process.

Syllabus:

Theory:

Unit – 1
***Metal Casting*:** Introduction, Tools, Types of Patterns, Pattern Materials, Types of casting – Sand, Die and other casting processes and Applications

Unit – 2
***Metal Forming*:** Introduction, Classification, Types of Bulk and sheet metal forming and Applications.

Unit – 3
***Powder Metallurgy*:** Introduction, Powder production methods, Compaction, Sintering, Secondary operations and Applications.

Unit – 4
Joining: Types of Joining, Introduction to Welding, Brazing and soldering, Arc, Solid state welding processes.

Unit - 5
***Conventional Machining processes*:** Introduction to machining operations; Lathe operations, Drilling, Milling and Grinding.
Unconventional Machiningprocesses.
CNC Machining and Additive manufacturing

PRACTICALS

List of Experiments:

1. **Fitting –** Step and V Fit
2. **Carpentry** – Half lap joint and Dove tail joint
3. **House Wiring** – Series, Parallel, Staircase and Godown wiring
4. **Tin Smithy** – Tray and Cylinder
5. **Welding** – Bead formation, Butt and Lap joint welding
6. **Foundry** – Mold preparation with Single piece and Split piece pattern
7. **Machining** – Plain turning, Facing, Step and Taper turning
8. **Plastic molding** – Demo

9. **WIRE EDM, CNC, 3D Printer** – Demo

Course Outcomes:

- Students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.
- Upon completion of this laboratory course
- Students will be able to fabricate components with their own hands.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

Reference Books:

1. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.
2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
3. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

CS1202 PROGRAMMING FOR PROBLEM SOLVING LAB

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**0-0-3**
Credits: 1.5	

List of Experiments:

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems e.g., sum of series
5. 1D Array manipulation
6. Matrix problems, String operations
7. Simple functions
8. Recursive functions
9. Pointers and structures
10. File operations

SECOND YEAR (E2) SEMESTER-I

S.NO.	Code	Course title	Category	Hours per week			Credits
				Lecture	Tutorial	Practical	
1	CH-MA2101	Mathematics-III	BS	3	1	0	4
2	CH-EE2101	Basic Electrical& Electronics Engineering.	ESC	3	0	0	3
3	CH2101	Material& Energy balance computations.	PCC	3	1	0	4
4	CH2102	Chemical Engineering Thermodynamics.	PCC	3	1	0	4
5	CH2103	Chemical Engineering Fluid Mechanics	PCC	3	1	0	4
6	MC210x	MC-I	MC	3	0	0	0
7	CH-EE2102	Basic Electrical& Electronics Engineering Lab.	ESC	0	0	3	1.5
8	CH2104	Chemical Engineering Fluid Mechanics Lab	PCC	0	0	3	1.5
9	CH2105	Seminar-I	SIP				1
						TOTAL	23

Mandatory Course-I: 1. Constitution of India
2. Indian Traditional Knowledge

CH-MA2101 **MATHEMATICS-III**

External marks: 60M	**L-T-P**
Internal marks: 40M	**4-0-0**
Credits: 4	

Course Objectives:

- To introduce Laplace Transforms and its applications in solving Differential equations.
- To introduce Linear and higher order Partial differential equations.
- To learn the different methods of solving partial differential equations.
- To study the applications of Partial differential equations
- To study the applications of probability and statistics.

Syllabus:

Unit-1

LAPLACE TRANSFORMS:

Introduction of Laplace Transforms, Sufficient Condition of Laplace Transforms, Laplace transforms of derivatives, Laplace Transforms of Integrals (I& II Shifting theorems),Laplace transforms of Unit Step functions,Dirac delta-function and error function, Periodic functions.

Differentiation of Laplace Transforms (Multiplication by t), Integration of Laplace Transform (division by t), Convolution theorem, Inversion.Solving Initial Value problems, System of Linear differential equations, Integral equations.

Unit-2

Introduction to PDE, formation of PDE, order, degree of PDE. Linear, semi-linear, quasi-linear, non-linear PDE of first order. Linear PDE of order one, Lagrange's method of solution and geometrical interpretation, non-linear PDE of order one, classification of integrals, compatibility condition, Charpit's method standard formulas. Solution to homogenous and non-homogenous linear partial differential equations second and higher order by complimentary function and particular integral method

Unit-3

Flows, vibrations and diffusions, second-order linear equations and their classification, Initial and boundary conditions (with an informal description of well-posed problems), Duhamel's principle for one dimensional wave equation.
Separation of variables method to simple problems in Cartesian coordinates.
Boundary-value problems: Solution of boundary-value problems for various linear PDEs in various geometries.

Unit-4

Series Solution of Differential Equations: Ordinary and singular points of an equation, Power series solution, Series solution about a Regular singular point, Frobenius method, Taylor's Series, Laurent's Series, Zeroes and Singularities, Residues, Residue theorem, Evaluation of real integrals using residue theorem, Bilinear Transform, Conformal Mapping.

Unit-5

Statistics and Probability: Probability laws: Addition and Multiplication theorems on probability, Baye's theorem, Expectation, Moments and Moment generating function of Discrete and continuous distributions, Binomial, Poisson and Normal distributions, Fitting these distributions to the given data, Testing of Hypothesis - Z-test for single mean and difference of means, Single Proportion and difference of proportions - T-test for single mean and difference of means, F-test for comparison of variances, Chi-square test for goodness of fit-Correlation, regression.

Course Outcomes:

Up on the successful completion of this course students will be able to

- Use the Laplace transform to compute solutions of second order, linear equations with constant coefficients
- To evaluate a contour integral using parameterization, fundamental theorem of calculus and Cauchy's integral formula

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons Ltd 2006.

2. R.K. Jain &S.R.K.Iyengar, Advanced Engineering Mathematics, Third Edition, Narosa publications, 2007.

3. Dr. M.D. Raisinghania,Ordinary andPartialdifferentialequations,S.CHAND,17th Edition2014.

Reference Books:

1. R.V.Churchill, "Complex Variables & its applications",Mc Graw-Hill Company, NC.

2. Ian N.Sneddon,Elements of Partial Differential Equations Dover publication (2006)

3. B.S. Grewal and J.S. Grewal, "Higher Engineering Mathematics",(40th Edition), Khanna Publishers,2007.

4. T.Amarnath, An elementary course in Partial Differential equations, Narosa Publishing house

CH-EE2101 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Course Objectives:
This course introduces the concept of

- Electrical DC and AC circuits, basic law's of electricity and methods to solve the electrical networks
- Construction operational features of energy conversion devices i.e. transformers, DC motors and induction motors.
- Basics of electronics, semiconductor devices and their characteristics and operational features.

Syllabus:

Unit-1
DC CIRCUIT ANALYSIS:
Electrical circuit elements: R-L-C Parameters, V–I relationship for Passive elements, Diode, Voltage and Current Independent and Dependent Sources.
Circuit analysis: Kirchhoff's Laws, Network reduction techniques – series, parallel, series parallel, star–to-delta, delta-to-star transformation, Source Transformation, Mesh Analysis and Nodal Analysis.
Network Theorems - Thevenin's, Norton's, Maximum Power Transfer, and Superposition
Step response of RL, RC and RLC circuits.

Unit -2
AC CIRCUIT ANALYSIS:
Single Phase AC Circuits: R.M.S. and Average values, Form Factor, steady state analysis of series, Parallel and Series parallel Combinations of R, L and C with Sinusoidal excitation, concept of reactance, Impedance, Susceptance and Admittance – phase and phase difference, Concept of Power Factor, j-notation, complex and Polar forms of representation.
Resonance – Series resonance and Parallel resonance circuits.

Unit-3
Three phase ac circuits -Three phase EMF generation, delta and Y connections, line and phase quantities, solution of three phase circuits, balanced supply voltage and balanced load, phasor diagram, measurement of power in three phase circuits.

Unit-4
BASIC ELECTRONICS:
Introduction to electronics and electronic systems, Diode and Rectifier circuits (Half and Full wave), BJT, Transistor biasing. Small signal transistor amplifiers (CE), Operational amplifiers and their basic application, Introduction to digital circuits.

Unit-5
ELECTRICAL MACHINES:
Transformers : Construction, EMF equation, ratings, phasor diagram on no load and full load, equivalent circuit, regulation and efficiency calculations, open and short circuit test, applications.
DC machines: Construction, EMF and Torque equations, Characteristics of DC generators and motors, applications.
Induction motors: The revolving magnetic field, principle of orientation, ratings, equivalent circuit, Torque-speed characteristics and applications.

Course Outcomes:
At the end of the course, the student will be able to:
- Understand the basic concept of electrical circuits under DC and AC excitation and solve basic electrical circuit problems
- Understand basic concept and performance of transformers and motors used as various industrial drives

Text Books:
1. Electrical Technology- Hughes Prentice Hall, 7th edition
2. Problems In Electrical Engineering- S. Parker Smith, 9 edition
3. Electronic Devices and Circuits – R.L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
4. Millman's Electronic Devices and Circuits – J.Millman and C.C.Halkias, Satyabratajit, TMH, 2/e, 1998.
5. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, Mc Graw Hill Company, 6th edition.
6. Electric Machines –by I.J.Nagrath & D.P.Kothari,Tata Mc Graw Hill, 7th Edition.2005

Reference Books:
1. Electronic Devices and Circuits - K. Lal Kishore, B.S. Publications, 2nd Edition, 2005.
2. Electronic Devices and Circuits – Anil K. Maini, Varsha Agarwal –Wiley India Pvt. Ltd. 1/e 2009.
3. Network Theory by N.C.Jagan & C.Lakshminarayana, B.S. Publications.
4. Press, W. H. et al., "Numerical Recipes in C: The Art of Scientific Computing, 3rd Edition, Cambridge University Press, 2007
5. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
6. Electrical machines-PS Bhimbra, Khanna Publishers.

CH2101 MATERIAL AND ENERGY BALANCE COMPUTATIONS

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 4

Course Objectives:

- To learn basic laws about the behavior of gases, liquids and solids and some basic mathematical tools.
- To Learn what material balances are, how to formulate and apply them, how to solve them.
- To Understand the heat properties such as heat capacity, latent heats for a given compound/mixtures.
- To learn the concepts of heat of reaction, exothermic and endothermic reactions, heat of formation, combustion; standard heat of formation, combustion and reaction, adiabatic flame temperatures and energy balances for models.

Syllabus:

Unit-1
Numerical techniques for solving material & energy balance equations. Explanation of log-log, semi log, triangle graphs, Composition of gaseous mixtures, liquid mixtures and solids etc. Ideal gas laws and its application, Dalton law, Raoult's law, Henry's laws, solubility and Distribution coefficient, Humidity and saturation.

Unit-2
Material Balance without Chemical Reactions: Fundamentals; Batch and flow processes, Steady-flow and unsteady processes, Material balance calculations for single-unit and Material balances for Multiple-unit processes, Process flow sheet, Material balance with and Without recycle; Bypass, Purge streams.

Unit-3
Material Balance with Chemical Reactions: Concept of limiting and excess reactants, Extent of Reaction, Material balances involving single reaction, Material balances involving multiple reactions.

Unit-4
Energy Balances without chemical reactions: Heat capacity of gases and gaseous mixtures, liquids & solids, Sensible heat change in liquid & gases, enthalpy changes during phase transformation, Enthalpy changes, thermo-chemistry of mixing process, dissolution of solids

Unit-5:
Energy Balances with chemical reactions: Heats of reaction, measurement and calculation of heats of reaction - Hess's Law, formation reactions and Heats of Formation, Heats of Combustion, Energy balances for combustion reactions - adiabatic reaction temperature,

theoretical flame temperature. Problems on combustion of coal, liquid fuels, gaseous fuel, sulfur and sulfur pyrites. Fuels And Combustion: Types of fuels, calorific value of fuels, Proximate, Orsat and ultimate analysis.

Course Outcomes:

- Ability to make material balances on unit operations and processes
- Ability to perform simultaneous material and energy balances
- Understanding of the degrees of freedom analysis and its significance
- Understanding of the concept of humidity and usage of psychrometric chart

Text Books:

1. Basic Principles and Calculations in Chemical Engineering, David M Himmelblau and James B Riggs, 7th Edition, PHI.

Reference Books:

1. Chemical process principles Part-I, Material and Energy Balance, O. A. Hougen, K. M. Watson, John Wiley and Asia Publication.
2. Stoichiometry (S.I units), B. I. Bhatt & S. M. Vora, McGraw Hill Ltd, 3rd Edition.
3. Elementary Principles of Chemical Processes, 2^{nd} edition, Richard M Felder, R W Rousseau. John Wiley.

CH2102 CHEMICAL ENGINEERING THERMODYNAMICS

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-1-0**
Credits: 4	

Course Objectives:

- To develop property relations for homogeneous phases and to understand various Thermodynamic diagrams.
- To introduce the concepts of chemical potential, partial properties, property relations for ideal gases, fugacity excess properties.
- To develop the theoretical foundation for applications of thermodynamics to gas mixtures and liquid solutions.
- To perform the phase equilibrium calculations using simple models for VLE, Gamma/Phi approach and equation of state approach.
- To understand concept of reaction equilibrium.

Syllabus:

Unit-1

Thermodynamic properties of pure fluids-Property relations for homogeneous phases, Gibbs free energy, Fundamental property relations, Residual properties.
Two phase systems, Thermodynamic diagrams, Tables of thermodynamic properties, generalized property correlations for gases and gas mixtures.

Unit -2

Solution Thermodynamics: Theory, Fundamental property relation, chemical potential as a criterion for phase equilibrium, partial properties, Residual properties, ideal gas mixtures, fugacity and fugacity coefficient for pure species, fugacity and fugacity coefficient for species in solutions, generalized correlations for Fugacity coefficient, The ideal solutions, excess properties.
Solution Thermodynamics Applications: The liquid phase properties from VLE data, models for the excess Gibbs energy, property changes of mixing.

Unit-3

VLE at low to moderate pressures-The nature of equilibrium, the phase rule, Duhems theorem, **VLE:** Qualitative behavior, the gamma /Phi formulation of VLE, Dew point and bubble point calculations, flash calculations, solute (1)/solvent (2) systems

Unit-4

Thermodynamic Properties and VLE from Equations of State- properties of fluids from the virial equations of state, properties of fluids from cubic equations of state, fluid properties from correlations of the Pitzer type, VLE from cubic equations of state.

Topics in Phase Equilibria- Equilibrium and stability, Liquid-Liquid Equilibrium (LLE), Vapor- Liquid–Liquid Equilibrium (VLLE), Solid-Liquid Equilibrium (SLE), Solid Vapor Equilibrium (SVE), Introduction to Molecular/Statistical Thermodynamics.

Unit-5

Chemical Reaction Equilibria: the reaction coordinate, application of equilibrium criteria to Chemical reactions, standard Gibbs free energy change, equilibrium constant, Effect of temperature on equilibrium constant, evaluation of equilibrium constants, relation of equilibrium constants to composition, equilibrium conversions for single reaction, phase rule and Duhem's theorem for reacting systems.

Course Outcomes:

At the end of the course, the student will be able to:

- Understand the terminology associated with engineering thermodynamics.
- Reiterate the first and second laws of thermodynamics, and understand the practical implications of these laws in engineering design.
- Understand the concepts of heat, work and energy conversion, and can calculate heat and work quantities for industrial processes.
- Calculate the properties of ideal and real mixtures based on thermodynamic principles.
- Determine changes in the properties of gases, fluids and solids undergoing changes in temperature and volume.
- Explain the underlying principles of phase equilibrium in two-component and multi-component systems.
- Understand processes involving power production, refrigeration, and liquifaction, and be able to calculate relevant system efficiencies for these processes.
- Understand the professional and ethical consequences of system design choices based on thermodynamic principles, and understand the impact of engineering solutions from a global and societal standpoint.
- Communicate effectively in writing regarding principles of the thermodynamic aspects of engineering design.
- Be knowledgeable in mathematics, science and engineering, and apply that knowledge to problems involving thermodynamics.

Text Books:

1. Introduction to Chemical Engineering Thermodynamics, J M Smith, H C Van Ness and M M Abbott, 6th Edition, TMH.

Reference Books:

1. Chemical Engineering Thermodynamics, Pradeep Ahuja, PHI Learning Pvt. Ltd., New Delhi, 2009.
2. A Text Book of Chemical Engineering Thermodynamics, K.V. Narayanan, PHI Learning Pvt. Ltd., New Delhi, 2001.

CH2103 CHEMICAL ENGINEERING FLUID MECHANICS

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 4

Course Objectives:

- Understand concepts on nature of fluids, pressure concepts and measurement of pressure by various experimental methods and by mathematical relations and enhancement of problem solving skills.
- Learn detailed explanation on types of fluids, stress and velocity relations, type of fluid flow and boundary layer relations.
- Understand relationship between kinetic energy, potential energy, internal energy and work complex flow systems using Bernoulli's equation with application to industrial problems.
- Understand clear concepts on Flow of incompressible fluids in conduits and thin layers and friction factor variations with velocity and friction losses using Bernoulli Equations and they will be demonstrated experimentally.
- Study Flow of compressible fluids, Dimensional analysis, Dimensional homogeneity and various dimensionless numbers and their applications.
- Understand principles and working of various types of pumps, transportation and metering of fluids using various experimental techniques and applications to industry.

Syllabus:

Unit-1
Unit systems, basic concepts, nature of fluids, Hydrostatic equilibrium, Applications of fluid statics, Fluid flow phenomena-Laminar flow, Shear rate, Shear stress, Rheological properties of fluids, Turbulence, Boundary layers.

Unit -2
Basic equations of fluid flow -Mass balance in a flowing fluid; continuity, differential momentum balance; Equations of motion, macroscopic momentum balances, Mechanical energy equations.

Unit-3
Incompressible Flow in pipes and channels shear stress and skin friction in pipes, laminar flow in pipes and channels.
Turbulent flow in pipes and channels, friction from changes in velocity or direction, Dimensional analysis including Buckingham π Theorem and Rayleigh's method.

Unit-4
Flow of compressible fluids -Definitions and basic equations, Processes of compressible flow, isentropic flow through nozzles, Basic concepts of adiabatic frictional flow and isothermal frictional flow.

Flow past immersed bodies-Drag and Drag coefficient, flow through beds of solids, motion of particles through fluids. Fluidization, Minimum fluidization velocity, Types of fluidization, applications of fluidization. Continuous fluidization: slurry and pneumatic transport.

Unit-5

Transportation of fluids-Pipes, tubes, fittings and valves, Seals, classification and selection of pumps, fans, blowers, and compressors. Pumps- developed head, suction lift and cavitation, NPSH, Characteristics curves of centrifugal pumps.

Metering of fluids: Constructional features and working principles of Venturimeter, Orifice meter, rotameter, pitot tube,target meter, magnetic meter etc.

Course Outcomes:

- Knowledge of basic principles of fluid mechanics.
- Ability to analyze fluid flow problems with the application of the momentum and energy equations.
- Capability to analyze pipe flows as well as fluid machinery.

Text Books:

1. Unit Operations of Chemical Engineering, W.L.McCabe, J.C.Smith & Peter Harriot, McGraw- Hill, 6th Edition, 2001.
2. Fluid Mechanics for Chemical Engineers, Noel de Nevers, 2nd edition, McGraw Hill International editions, 1991.

Reference Books:

1. Introduction to Fluid Mechanics, Fox and Mc Donald, 8th Edition.
2. Transport processes and unit operations, Christie J. Geankoplis, PHI.

MC210x **CONSTITUTION OF INDIA**

(MC-I)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 0

Course Objectives:

- Sensitization of student towards self, family (relationship), society and nature.
- Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
- Strengthening of self reflection.
- Development of commitment and courage to act.

Syllabus:

Unit-1

Constitution of India – Basic features and fundamental principles:

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India, Salient features and characteristics of the Constitution of India, Scheme of the fundamental rights, The scheme of the Fundamental Duties and its legal status, The Directive Principles of State Policy – Its importance and implementation, Federal structure and distribution of legislative and financial powers between the Union and the States, Parliamentary Form of Government in India – The constitution powers and status of the President of India, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions : National Emergency, President Rule, Financial Emergency, Local Self Government – Constitutional Scheme in India, Scheme of the Fundamental Right to Equality, Scheme of the Fundamental Right to certain Freedom under Article 19, Scope of the Right to Life and Personal Liberty under Article 21.

Unit-2

Universal Human Values – 1

Unit-3

Environment Science

Unit-4

Essence of Indian Knowledge Tradition

Unit-5

Learning an Art Form (Music: vocal or instrumental, dance, painting, clay modeling, etc.)

Course outcomes:

- At the end of the course, students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind.
- They would have better critical ability. They would also become sensitive to their commitment towards what they believe in (humane values. humane relationships and humane society).
- It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

MC210x ESSENCE OF INDIAN KNOWLEDGE TRADITION (MC-I)

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-1-0**
Credits: 0	

ESSENCE OF INDIAN KNOWLEDGE TRADITION-Pt-1

भारतीयविद्यासार - 1

Course Objective

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course contents

- Basic Structure of Indian Knowledge System: अष्टादश विद्या - ४ वेद, ४ उपवेद (आयुर्वेद, धनुर्वेद, गान्धर्व वेद, स्थापत्य आदि), ६ वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद), ४उपाङ्ग (धर्म शास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health Care
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India – course material*, BharatiyaVidyaBhavan, Mumbai,5th Edition, 2014
- Swami Jitatmanand, *Modern Physics and Vedant*, BharatiyaVidyaBhavan.
- Swami Jitatmanand, *Holistic Science and Vedant*, BharatiyaVidyaBhavan.
- Fritzof Capra, *Tao of Physics*.
- Fritzof Capra, *The Wave of Life*.
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkatta.
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, VidyanidhiPrakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, VidyanidhiPrakashan, Delhi 2016
- P B sharma (English translation), *ShodashangHridayam*

Pedagogy: Problem based learning, group discussions, collaborative mini projects

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledgein modern scientific perspective.

ESSENCE OF INDIAN KNOWLEDGE TRADITION – Pt-2

भारतीयविद्यासार - 2

Course Objective

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-2 focuses on Indian philosophical traditions, Indian linguistic Tradition, and Indian artistic tradition.

Course contents

- Philosophical Tradition(सर्वदर्शन) – न्याय, वैशेषिक, सांख्य, योग, मीमांसा, वेदान्त, चार्वाक, जैन, बौद्ध
- Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)
- Indian Artistic Tradition –चित्रकला, मूर्तिकला, वास्तुकला, स्थापत्य, संगीत, नृत्यएवंसाहित्य
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India – course material*, BharatiyaVidyaBhavan, Mumbai, 5th Edition, 2014
- S.C.Chaterjee&D.M.Datta, *An Introduction to Indian Philosophy*, University of Calcutta, 1984
- KS SubrahmaniaIyer, *Vakyapadiya of Bhartrihari, (Brahma Kanda)*, Deccan College Pune 1965
- *Panini Shiksha*, MotilalBanarasidas
- VN Jha, *Language, Thought and Reality*.
- वासुदेवशरणअग्रवाल, कलाएवंसंस्कृति, साहित्यभवन, इलाहाबाद, 1952
- Pramod Chandra, *India Arts*, Howard Univ. Press, 1983
- Krishna Chaitanya, *Arts of India*, Abhinav Publications, 1987
- R Nagaswamy, *Foundations of Indian Art*, Tamil Arts Academy, 2002

Pedagogy: Problem based learning, group discussions, collaborative mini projects

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledgein modern scientific perspective.

ESSENCE OF INDIAN KNOWLEDGE TRADITION – Pt-2

भारतीयविद्यासार - 2

Course Objective

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-2 focuses on Indian philosophical traditions, Indian linguistic Tradition, and Indian artistic tradition.

Course contents

- Philosophical Tradition(सर्वदर्शन) – न्याय, वैशेषिक, सांख्य, योग, मीमांसा, वेदान्त, चार्वाक,जैन, बौद्ध
- Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)
- Indian Artistic Tradition –चित्रकला, मूर्तिकला, वास्तुकला,स्थापत्य, संगीत, नृत्यएवंसाहित्य
- Case studies

References

- V. Sivaramakrishnan [Ed.], *Cultural Heritage of India – course material*, BharatiyaVidyaBhavan, Mumbai,5th Edition, 2014
- S.C.Chaterjee&D.M.Datta, *An Introduction to Indian Philosophy*,University of Calcutta, 1984
- KS Subrahmanialyer, *Vakyapadiya of Bhartrihari, (Brahma Kanda)*, Deccan College Pune 1965
- *Panini Shiksha*, MotilalBanarasidas
- VN Jha, *Language, Thought and Reality*,
- वासुदेवशरणअग्रवाल, कलाएवंसंस्कृति, साहित्यभवन, इलाहाबाद, 1952
- Pramod Chandra, *India Arts*, Howard Univ. Press, 1983
- Krishna Chaitanya, *Arts of India*, Abhinav Publications, 1987
- R Nagaswamy, *Foundations of Indian Art*, Tamil Arts Academy, 2002

Pedagogy: Problem based learning, group discussions, collaborative mini projects

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledgein modern scientific perspective.

CH-EE2102 BASIC ELECTRICAL & ELECTRONICS ENGINEERING LABORATORY

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**0-0-3**
Credits: 1.5	

Course Objectives:

- To expose the students to the concepts of electrical and electronics circuits and their applications
- To expose the students to the operation of dc machines and transformer and give them experimental skills

List of Experiments:

List of Laboratory Experiments/Demonstrations (any eight of the following):

1. Introduction to Lab:
   (a) Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
   (b) Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.

2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.

3. Transformers: Observation of the no-load current waveform on an oscilloscope (non sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.

4. Torque Speed Characteristic of separately excited dc motor.

5. Torque-Slip Characteristic of an induction motor.

6. Characteristic of the lamps (Tungsten, Fluorescent and Compact Fluorescent Lamps).

7. Verification of Network Theorems.

8. V-I characteristics of Diodes and BJT.

9. Half-wave and full-wave rectifiers, rectification with capacitive filters, zener diode

10. Studies on logic gates

11. Small signal transistor amplifiers (CE)

Course Outcomes:

- Get an exposure to basic electrical laws.
- Understand the response of different types of electrical circuits to different excitations.
- Understand the measurement, calculation and relation between the basic electrical parameters
- Understand the basic characteristics of transformers and electrical machines.

CH2104 CHEMICAL ENGINEERING FLUID MECHANICS LAB

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**0-0-3**
Credits: 1.5	

Course Objectives:

- Know the different types of flow using Reynolds apparatus.
- Verify the Bernoulli's equation by using Bernoulli's apparatus.
- Calibrate the Rotameter.
- Find out the variation of orifice coefficients with Reynolds Number.
- Determine the venturi coefficient by using venturimeter.
- Find out the frictional losses in flow through pipes.
- Study the coefficient of contraction in an open orifice.
- Study the coefficient of discharge in V- Notches.
- Study the characteristic of a centrifugal pump.
- Find out the pressure drop in packed bed for different velocities.

List of experiments:

1. Identification of laminar and turbulent flows.
2. Measurement of point velocities.
3. Verification of Bernoulli's equation.
4. Calibration of Rotameter.
5. Variation of Orifice coefficient with Reynolds Number.
6. Determination of Venturi coefficient.
7. Friction losses in Fluid flow in pipes.
8. Pressure drop in a packed bed for different fluid velocities.
9. Pressure drop and void fraction in a fluidized bed.
10. Studying the coefficient of contraction for a given open orifice.
11. Studying the coefficient of discharge in a V-notch.
12. Studying the Characteristics of a centrifugal pump.

List of Equipment:

Reynolds apparatus, Pitot tube setup, Bernoulli's Apparatus, Rotameter Assembly, Orifice meter Assembly, Venturi meter Assembly, Pipe Assembly with provision for Pressure measurement, Packed bed with Pressure drop measurement, Fluidized bed with Pressure drop measurement, Open Orifice Assembly, V-notch Assembly, Centrifugal Pump

Course Outcomes:

- Identify, name, and characterize flow patterns and regimes.
- Understand basic units of measurement, convert units, and appreciate their magnitudes.
- Utilize basic measurement techniques of fluid mechanics.
- Discuss the differences among measurement techniques, their relevance and applications.
- Measure fluid pressure and relate it to flow velocity.
- Demonstrate practical understanding of the various equations of Bernoulli.

- Demonstrate practical understanding of friction losses in internal flows.
- Demonstrate practical understanding of boundary layers, separation, drag and lift.

CH2105 SEMINAR-1

Externals: 100 Marks **L-T-P**
0-0-0

Credits: 1

Course Objectives:
- To improve the presentation skills
- To prepare PPT more effectively

Course Outcomes:
- Student will better understand the role that effective presentations have in public/professional contexts and gain experience in formal/ informal presentation.
- Student has to choose a general topic to give a power point presentation

SECOND YEAR (E2)- SEMESTER II

S.NO.	Code	Course title	Category	Hours per week			Credits
				Lecture	Tutorial	Practical	
1	CH-MM2201	Material Science	ESC	3	0	0	3
2	CH2201	Process Heat Transfer	PCC	3	1	0	4
3	CH2202	Mechanical Unit Operations	PCC	3	0	0	3
4	CH2203	Mass Transfer Operations-I	PCC	3	1	0	4
5	BM2001	HASS-III	HSMC	3	0	0	3
6	BSBE2201	MC-II	MC	3	0	0	0
7	CH2204	Process Heat Transfer Lab	PCC	0	0	3	1.5
8	CH2205	Mechanical Unit Operations Lab	PCC	0	0	3	1.5
						TOTAL	20

HASS-III: Managerial Economics and Financial Analysis
Mandatory Course-II: Environmental Science

CH-MM2201 **MATERIAL SCIENCE**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Course Objectives:

- Understand concepts on properties and selection of metals, ceramics, and polymers for design and manufacturing.
- Study variety of engineering applications through knowledge of atomic structure, electronic structure, chemical bonding, crystal structure, x-rays and x-ray diffraction, defect structure.
- Study Microstructure and structure-property relationships, Phase diagrams, heat treatment of steels.
- Study detailed information on types of corrosion and its prevention.
- Learn information on selection of materials for design and manufacturing.

Syllabus:

Unit-1
Introduction: Engineering Materials – Classification – levels of structure.
Crystal Geometry and Structure Determination: Space lattice and Unit cell. Bravais lattices, crystal systems with examples. Lattice coordinates, Miller indices, Bravais indices for directions and planes: crystalline and non crystalline solids; ionic, covalent and metallic solids; packing efficiency, coordination number; structure determination by Bragg's X-ray diffraction and powder methods.

Unit -2
Crystal Imperfection: Point defects, line defects-edge and screw dislocation, Berger's circuit and Berger's vectors, dislocation reaction, dislocation motion, multiplication of dislocations during deformation , role of dislocation on crystal properties; surface defects, dislocation density and stress required to move dislocations, stacking faults.

Unit-3
Basic thermodynamic functions: phase diagrams and phase transformation: Primary and binary systems-general types with examples; tie line, lever rule and phase rule, non equilibrium cooling: phase diagrams of Fe-Fe_3C, Pb-Sn, Cu-Ni systems.
Types of steels: Plain carbon steels and alloy steels, effect of alloying elements on properties of steels and other metals used in chemical industry

Unit-4
Elastic, an elastic and plastic deformations in solid materials; rubber like elasticity, visco elastic behavior (models); shear strength of real and perfect crystals, tensile properties of steels, work hardening mechanisms, cold working, hot working; dynamic recovery, recrystallization, grain growth.

Unit-5

Fracture in ductile and brittle materials, creep: Mechanism of creep and methods to reduce creeping in materials, creep rates and relations. Fatigue-mechanisms and methods to improve fatigue resistance in materials.

Composite materials: types; stress-strain relations in composite materials, applications.

Oxidation and Corrosion: Mechanisms of oxidation, oxidation resistant materials, principles and types of corrosion, protection against corrosion.

Course Outcomes:

- Students will be able to understand the crystallographic changes in the materials which occur with the variation in temperature and apply the knowledge of structure property relationship in various metallurgical operations.
- An understanding of crystal geometry is developed and the student will be able to identify and index different planes and directions in metals and compounds which are of importance in metallurgical and chemical engineering operations.
- An insight into different defects in the crystals is given.
- An ability to predict solid solution formation of a given set of metals and associated phase transformations is developed by the study of phase diagrams.
- Structure property relations of several metals are analyzed with reference to their crystal structures, phase compositions, working conditions, defect concentration etc.,
- Student will be able to predict the conditions of failure in materials under a given set of conditions.
- This inter-disciplinary course is expected to arouse in the students an interest and understanding of different metallurgical systems which are applicable in chemical processes.

Text Books:

1. Materials Science and Engineering, 5^{th}ed. V. Raghavan, PHI Learning Pvt. Ltd., New Delhi, 2009.
2. Physical Metallurgy – V. Raghavan.
3. Material Science and Engineering – Callister.
4. Introduction to Physical Metallurgy – Avner.
5. Material science and Metallurgy – V. D. Kodgire, S. V. Kodgiri.

Reference Books:

1. Elements of Materials Science, L.R. Van Vlack.
2. Science of Engineering Materials, vols. 1&2, Manas Chanda, McMillan Company of India Ltd.

CH2201 **PROCESS HEAT TRANSFER**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 4

Course Objectives:

- Study various modes of Heat transfer and their fundamental relations.
- Study conduction heat transfer and develop mathematical relations for various solid geometries.
- Understand different types of heat transfer coefficients and their estimations in various types of flows in different geometries.
- Understand the working of Heat exchangers and to learn design of double pipe, shell and tube heat exchangers and design of evaporators and conduct experiments and to submit the report.
- Understand the phenomenon of radiation, radiation shields and estimation of emissivity.

Syllabus:

Unit-1
Introduction & Heat transfer by conduction: Nature of heat flow, Heat transfer by conduction in Solids Fourier's law, thermal conductivity, steady state conduction in plane wall & composite walls, compound resistances in series, Thermal Insulation.
Heat flow through a cylinder, conduction in spheres, thermal contact resistance, plane wall: variable conductivity. Unsteady state heat conduction Equation for one-dimensional conduction, Semi-infinite solid and finite solid.

Unit -2
Heat Transfer to Fluids without Phase change: Regimes of heat transfer in fluids, thermal boundary layer, heat transfer by forced convection in laminar flow, Heat transfer by forced convection in turbulent flow, the transfer of heat by turbulent eddies and analogy between transfer of momentum and heat.

Unit-3
Natural convection -Natural convection to air from vertical shapes and horizontal planes, effect of natural convection in laminar flow heat transfer, free convection in enclosed spaces, mixed free & forced convection
Heat transfer to fluids with phase change -Heat transfer from condensing vapors, heat transfer to boiling liquids.

Unit-4
Heat exchange equipment: General design of heat exchange equipment, heat exchangers, condensers, Boilers and Calendrias, extended surface equipment, heat transfer in agitated vessels, scraped surface heat exchangers, heat transfer in packed beds, heat exchanger effectiveness (NTU method).

Unit-5

Radiation -Properties and definitions, black body radiation, real surfaces and the gray body. Absorption of radiation by opaque solids, radiation between surfaces, radiation shielding, radiation to semi transparent materials.

Evaporators – Various types of Evaporators, performance of tubular evaporators, capacity and economy, single and multiple effect evaporators, vapour recompression.

Course Outcomes:

- Ability to understand and solve conduction, convection and radiation problems.
- Ability to design and analyze the performance of heat exchangers and evaporators.
- Ability to design and analyze reactor heating and cooling systems.

Text Books:

1. Unit Operations of Chemical Engineering, W. L. McCabe, J. C. Smith & Peter Harriot, 6th Edition, McGraw-Hill.
2. Transport processes and Unit operations, Christie J. Geankoplis, PHI.

Reference Books:

1. Process heat transfer, D. Q. Kern, McGraw-Hill.
2. Heat Transfer, 9^{th} ed., J.P. Holman, McGraw-Hill, New York.,2004
3. Heat Transfer by B. K. Dutta.

CH2202 MECHANICAL UNIT OPERATIONS

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-0-0**
Credits: 3	

Course Objectives:

This course deals with the different mechanical unit operations in chemical engineering. Specific attention is given on particle and separation techniques.

- Student will gain knowledge on various mechanical separation operations used in chemical industry.
- Classify and identify the storage, mixing and transportation equipment.
- Calculate the average size of solid particles of a given solid sample. Describe size reduction equipment and distinguish between different size reduction equipment.
- Choose the type of filtration process for a solid liquid separation.
- Explain the flow patterns in an agitator.

Syllabus:

Unit-1

Introduction to unit operations: Properties, handling and mixing of particulate solids: Characterization of solid particles(Micro, Macro and Nano), properties of particulate masses, storage and mixing of solids-Bulk storage, Bin storage & Silos, Transportation of solid particulate mass, belt, screw, apron conveyers, bucket elevators, pneumatic conveying.

Unit -2

Size reduction -Principles of comminution, size reduction equipment-Crushers (Jaw Crusher, Gyratory Crusher), Grinders (Ball mill, Tumbling mills), Ultra fine grinders (Fluid energy mills), Cutting machines, Equipment operation-Open circuit & closed circuit operation.
Laws of crushing: Kick's law, Bond's law, Rittinger's law.
Screening, differential & cumulative analysis, Industrial screening equipments-Stationary screens and grizzlies, Gyrating screens, Vibrating screens, comparison of ideal and actual screens, Material balances over screen, capacity and effectiveness of screens.

Unit-3

Filtration-Types of filters, cake filters, constant rate filtration, constant pressure filtration, centrifugal filters-Plate and Frame filter press, Chamber press, Rotary Drum filter, Vacuum Nutch filter, top suspended batch centrifuge, filter aids, Principles of cake filtration. Clarifying filters, liquid clarification, gas cleaning, Principles of clarification. Cross flow filtration, types of membranes, micro filtration.

Unit-4

Separations based on motion of particles through fluids, gravity settling processes-gravity classifiers, sorting classifiers- float and sink method, differential settling method, coagulation, flocculation and flocculating agents, Size Enlargement- Nucleation and growth of particles, centrifugal settling processes-cyclone separators & hydro cyclones. Centrifugal decanters-Tubular & Disk centrifuge.

Unit-5

Electro-static precipitators, Flotation-separation of ores, flotation agents, Magnetic separators-Ball Norton machine, magnetic pulley separator & magnetic drum separator.
Agitation and mixing of liquids: Agitation of liquids, Types of impellers-propellers, turbines, paddles. Flow patterns in agitated vessels, power consumption in agitated vessels

Course Outcomes:

At the end of the course, the student will be able to:

- Size piping networks, valves, pumps for flow systems.
- Understand flow past immersed objects especially in fixed and fluidized beds and derive the Ergun equation.
- Design a mixed tank, calculate its power requirements and scale-up the design.
- Understand and apply the basic methods of characterization of particles and bulk solids, e.g.average particle size, settling velocity.
- Describe the operation of filter processes and types of filters used to perform solid-liquid separations, and calculate their power requirements.

Text Books:

1. Unit Operations in Chemical Engineering, W.L. McCabe and J.C. Smith and Peter Harriott, Mc Graw Hill, 7th ed. 2001.

Reference Books:

1. Chemical engineers hand book, J.H. Perry, 7th ed. Mc Graw Hill
2. Introduction to Chemical Engineering, J.T.Banchero & W.L. Badger., TMH, 1997.

CH2203 **MASS TRANSFER OPERATIONS-I**

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-1-0**
Credits: 4	

Course Objectives:

- To discuss the fundamental concepts of mass transfer principles and to apply those concepts to real engineering problems.
- To impart the basic concepts of molecular diffusion, mass transfer coefficients and analysis of different mass transfer processes
- Applies the concepts of diffusion mass transfer, mass transfer coefficients, convective mass transfer, inter-phase mass transfer, equipment for gas-liquid operations.

Syllabus:

Unit-1

Classification of the Mass-Transfer Operations, Molecular Diffusion in Fluids: Molecular diffusion, Fick's Law of Diffusion, Equation of Continuity, binary solutions, Steady State Molecular Diffusion in Fluids at Rest and in Laminar Flow. Gas-Phase Diffusion Coefficient: Use of Stefan Tube. Liquid-Phase Diffusion Coefficient estimation.

Unit -2

Basics of Diffusion in Solids and Unsteady State Diffusion. Mass Transfer Coefficients: F-type and k-type coefficients, Theories of Mass Transfer: Film theory, Penetration theory, surface renewal theory and Boundary layer theory. Wetted wall column, Mass, Heat and Momentum Transfer Analogies.

Unit-3

Inter-Phase Mass Transfer: Concept of Equilibrium, Diffusion between Phases, material Balances in Steady State Co-current and Countercurrent Processes, Stages, Kremser-Brown equations.

Gas-Liquid Operations: Tray Towers, Tray efficiency: Murphree tray efficiency. Packed Bed Towers- Types of Packing. Tray Towers Vs Packed Towers.

Unit-4

Absorption and Stripping: Absorption equilibrium, Ideal and Non-Ideal Solutions: Raoult's law, Henry's law. Selection of a Solvent for Absorption, one component transferred: material balances, minimum liquid-gas ratio for absorbers. Countercurrent multistage operation: one component transferred, the Absorption factor, determination of number of stages. Continuous-contact equipment: HETP, HTU, NTU determination.

Unit-5

Humidification and Dehumidification: Humidification Principles, Absolute Humidity, Unsaturated vapor-gas mixtures, adiabatic saturation curves, wet bulb temperature, the Lewis

relation, the Psychometric chart and its use. Description of cooling towers- construction and operation.
Drying: Definitions, Drying operations: Batch drying, the rate of batch drying, the mechanism of batch drying. Continuous drying: Classification drying equipment: Conveyer dryer, rotary dryers.

Course Outcomes:

- Students will learn about the diffusional mass transfer.
- Operation of cooling tower will be clearly understood.
- Operation of Dryer will be understood.
- Student will understand the mechanism of crystallization and absorption.

Text Books:

1. Mass Transfer Operations, 3rd ed., R. E. Treybal, McGraw-Hill, New York.
2. Principles of Mass Transfer and Separation processes, Binary K. Dutta PHI Learning Pvt. Ltd., New Delhi, 2012.

Reference Books:

1. Unit operations in chemical engineering, W.L. McCabe and J.C. Smith and Peter Harriott, Mc Graw Hill, 7th ed. 2001.

BM3001 **Managerial Economics and Financial Analysis (HASS-III)**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Syllabus:

Unit-1
Introduction to Managerial Economics:
Definition, Nature and Scope of Managerial Economics-Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting.

Unit-2
Theory of Production and Cost Analysis:
Production Function - Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs. Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale.
Cost Analysis: Cost concepts, Opportunity cost. Fixed vs. Variable costs, Explicit costs Vs. Implicit costs. Out of pocket costs vs. Imputed costs. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems)- Managerial Significance and limitations of BEA.

Unit-3
Markets & Pricing Policies:
Market structures: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. Objectives and Policies of Pricing- Methods of Pricing: Cost Plus Pricing. Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing.

Unit-4
Introduction to Financial Accounting:
Introduction to Financial Accounting: Double entry Book Keeping, Journal, Ledger, Trail Balance and Final Accounts (Trading account, Profit and Loss Account and Balance sheet with simple adjustments).

Unit-5
Capital and Capital Budgeting:
Capital and Capital Budgeting: Capital and its significance. Types of Capital. Estimation of Fixed and Working capital requirements. Methods and sources of raising finance. Nature and scope of capital budgeting, features of capital budgeting proposals. Methods of Capital Budgeting: Payback Method. Accounting Rate of Return (ARR) and Net Present Value Method, Internal Rate of Return (IRR).

Reference Books:

1. Aryasri: Managerial Economics and Financial Analysis, TMH,2009.
2. Varshney & Maheswari : Managerial Economics, Sulthan Chand,2009.
3. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis, Scitech. 2009.
4. V.Rajasekarn & R.Lalitha. Financial Accounting, Pearson Education. New Delhi. 2010
5. Suma Damodaran, Managerial Economics, Oxford University Press. 2009.

BSBE2201 **ENVIRONMENTAL SCIENCE**
(MC-II)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 0

Course Objectives:

- Stimulate interest in the environment and endeavors to generate awareness about environmental concerns among students.
- Develop an understanding of how natural resources and the environment affect quality of life and the quest for sustainable development.
- Develop knowledge and understanding of environmental issues and principle and apply their knowledge to mitigate the environmental problems.
- Understand and resolve some of today's most challenging scientific and policy issues including global climate change, pollution, biodiversity conservation, sustainability, environmental pollution and toxic waste disposal, disease control, disaster management, socio-environmental issues and balancing resource use and preservation.
- Design and evaluate strategies, technologies, and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.
- Recognizes the global changes and responses for attaining a more sustainable environment.

Syllabus:

Unit-1
Multi disciplinary nature of environmental studies: Definition, scope and importance, need for public awareness

Unit -2
Natural resources: Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

Unit-3
Ecosystem and Biodiversity:
Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.
Introduction, types, characteristic features, structure and function of the following ecosystems:-

a) i).Forest ecosystem ii).Grassland ecosystem iii).Desert ecosystem iv).Aquatic ecosystems (ponds, streams, lakes, rivers, oceans and estuaries).
b) Biodiversity- Definition: genetic, species and ecosystem diversity. Bio geographical classification of India Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
c) Biodiversity at global, National and local levels. India as a mega-diversity nation Hot-sports of biodiversity.
d) Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit-4
Environmental pollution: Definition, Cause, effects and control measures of :- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards

a) Solid waste Management: Causes, effect s and control measures of urban and industrial wastes.
b) Role of an individual in prevention of pollution
c) Pollution case studies.
d) Disaster management: floods, earthquake, cyclone and landslides.
e) Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
f) Environment Protection Act., Air (Prevention and Control of Pollution) Act. Water Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.

Unit-5
Social issues and the environment: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Field work: Visit to a local area to document t environmental assets river/ forest/grassland/hill/mountain Visit to a local polluted site-Urban/Rural/Industrial/Agricultural. Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes etc.

Course Outcomes:

- Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn help in sustainable development.

Reference Books:

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad- 380 013, India, Email:mapin@icenet.net
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB).
5. Cunningham, W.P. Cooper, T.H. Gorhan i, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 116p.

CH2204 **PROCESS HEAT TRANSFER LAB**

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **0-0-3**
Credits: 1.5

Course Objectives:

- This lab will provide practical knowledge on various heat transfer process and equipment like heat exchangers and evaporators.
- Learn basic Heat transfer principles.
- Impart the knowledge in heat transfer measurements and different heat transfer equipment.
- Learn how the convection takes place in natural and forced convection and gain knowledge of the heat transfer taking place in different heat exchangers.

List of Experiments:

1. Determination of total thermal resistance and thermal conductivity of composite wall.
   Major equipment - Composite wall Assembly.
2. Determination of thermal conductivity of a metal rod.
   Major equipment - Thermal Conductivity apparatus.
3. Determination of natural convective heat transfer coefficient for a vertical tube.
   Major equipment - Natural convection heat transfer apparatus.
4. Determination of critical heat flux point for pool boiling of water.
   Major equipment- Pool boiling apparatus.
5. Determination of forced convective heat transfer coefficient for air flowing through a pipe.
   Major equipment – Forced convection heat transfer apparatus.
6. Determination of overall heat transfer coefficient in Shell and Tube heat exchanger.
   Major equipment – Shell and Tube heat exchanger apparatus.
7. Determination of thermal conductivity of a Liquid.
   Major equipment - Thermal Conductivity apparatus.
8. Determination of Stefan – Boltzmann constant.
   Major equipment - Stefan Boltzmann apparatus.
9. Determination of emissivity of a given plate at various temperatures.
   Major equipment - Emissivity determination apparatus.

Course Outcomes:

By the end of this course, the student should be able to:

- Understanding fundamentals of some major Heat transfer operation.
- Development of design processes
- Application of design principles for heat transfer devices.
- Learning operations of various heat transfer systems
- Building foundation for process intensification
- Motivation towards innovations for novel systems of heat transfer.

CH2205 MECHANICAL UNIT OPERATIONS LAB

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **0-0-3**
Credits: 1.5

Course Objectives:

- To enable the students to develop a sound working knowledge on different types of crushing equipments and separation characteristics of different mechanical operation separators.

List of experiments:

1. To determine the time of grinding in a ball mill for producing a product with 80 % passing a given screen.
   Major equipment - Ball mill Apparatus, Sieve shaker, Different sizes of sieves, weighing balance.
2. To verify the laws of crushing using any size reduction equipment and to find out the working index of the material.
   Major equipment – Jaw Crusher, Sieve shaker, Different sizes of sieves, Weighing Balance, Energy meter.
3. To find the effectiveness of hand screening and vibrating screen of a given sample.
   Major equipment - Vibrating Sieve shaker, Different sizes of sieves, Weighing Balance.
4. To achieve beneficiation of a ore using froth flotation technique.
   Major equipment - Froth flotation cell
5. To obtain batch sedimentation data and to calculate the minimum thickener area under given conditions.
   Major equipment- Sedimentation apparatus
6. To determine the specific cake resistance and filter medium resistance of slurry in plate and frame filter press.
   Major equipment - Plate and frame filter press.
7. To determine reduction ratio of a given sample in a grinder.
   Major equipment - Grinder
8. To determine the viscosity of a liquid by using stokes law and by VISCOMETER Instrument
9. To calculate separation efficiency of particles in a mixture using cyclone separator.

Course Outcome:

By the end of this course, the student should be able to:

- Size piping networks, valves, pumps for flow systems.
- Understand flow past immersed objects especially in fixed and fluidized beds and derive the Ergun equation.
- Design a mixed tank, calculate its power requirements and scale-up the design.
- Understand and apply the basic methods of characterization of particles and bulk solids, e.g.Average particle size, settling velocity.
- Describe the operation of filter processes and types of filters used to perform solid-liquid separations, and calculate their power requirements.

THIRD YEAR(E3)- SEMESTER I

S.NO.	Code	Course title	Category	Hours per week			Credits
				Lecture	Tutorial	Practical	
1	CH3101	Chemical Reaction Engineering-I	PCC	3	1	0	4
2	CH3102	Mass Transfer Operations-II	PCC	3	1	0	4
3	CH3103	General Chemical Technology (GCT)	PCC	3	0	0	3
4	CH3104	Core Elective-1	PCE	3	0	0	3
5	CH3105	Core Elective-II	PCE	3	0	0	3
6	MC310x	MC-III	MC	3	0	0	0
7	CH3106	Mass Transfer Laboratory	PCC	0	0	3	1.5
8	CH3107	Chemical Engineering Analytical Laboratory	PCC	0	0	3	1.5
9	CH3108	Seminar-II	SIP	0		0	1
						TOTAL	21

Core Elective-I:

1. Environmental Pollution Control Engineering
2. Nuclear Process engineering
3. Nano Technology

Core Elective-II:

1. Numerical Methods in Chemical Engineering
2. Industrial safety and Hazard Mitigation
3. Fertilizer Technology

Mandatory Course-III:

1. Constitution of India
2. Indian Traditional Knowledge

CH3101 **CHEMICAL REACTION ENGINEERING-I**

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-1-0**
Credits: 4	

Course Objectives:

- The emphasis of this course is on the fundamentals of chemical reaction kinetics and chemical reactor operation.
- The overall goal of this course is to develop a critical approach toward understanding complex reaction systems and elucidating chemical reactor design.
- Integrate concepts from science & engineering to constitute a basis for the design of chemical reactor, a key element in the design of chemical process.
- Provide a foundation on deriving rate expressions for series, parallel, reversible reactions and the knowledge about product distribution in multiple reactions, recycle reactors and auto catalytic reactions.
- Understand effect of temperature and pressure on reacting systems

Syllabus:

Unit-1

Introduction. Classification of chemical reactions; single, multiple, elementary and non-elementary homogeneous reactions; reaction rate, order and Molecularity; Collision theory and Transition-state theory, Arrhenius relation. Reaction Mechanisms.

Unit-2

Interpretation of Batch reactor data:

Constant volume batch reactor: Integral analysis and differential Analysis of batch reactor data. Half-life period, fractional life period. Reversible and irreversible reactions. Autocatalytic reactions. Variable volume batch reactor. Analysis of Variable volume batch reactor

Unit-3

Introduction to Reactor design for homogeneous isothermal reactions,Ideal Batch rector, Ideal CSTR reactor design, Ideal plug flow Reactor Design.

Design for single reactions: Comparison of Ideal Reactors for single reaction. Reactors in series, Reactors of different types in series, Design of Recycle reactor, Optimum recycle ratio, Best reactor system setup for given conversion. Best reaction system for autocatalytic reactions.

Unit-4

Design for Parallel reactions-Introduction to multiple reactions, Product distribution, quantitative treatment of product distribution-instantaneous yield, Overall yield, Selectivity, various contacting patterns.

Design for Series reactions –irreversible series first order reactions-yield analysis in batch reactor, plug flow reactor and mixed flow reactor,
Design for reactions with change in order; Design considerations for Reversible reactions in series.
Design considerations for Series-Parallel reactions; Denbigh reactions.

Unit-5
Temperature and pressure effects:
Equilibrium constant and effect of temperature on equilibrium conversion-exothermic and endothermic reactions, General graphical design procedure, Optimum temperature progression,
Adiabatic operation and Non-adiabatic operation; Exothermic reactions in Mixed flow reactor. Multiple reactions-product distribution, choosing the right kind of reactor.

Course Outcomes:

- Develop rate laws for homogeneous reactions.
- Design of ideal reactors for single and complex reactions.
- Develop skills to choose the right reactor among single, multiple, recycle reactor, etc. schemes.
- Design of non-isothermal reactors and the heat exchange equipment required.

Text Books
1. Chemical Reaction Engineering, Octave Levenspiel, Wiley Eastern, 3rd ed., Tata McGraw Hill.

Reference:

- Elements of Chemical Reaction Engineering, H S Fogler, 4th Edition, PHI.
- The Engineering of Chemical Reactions, 2^{nd} ed., L.D. Schmidt, Oxford University Press, New Delhi, 2010.

CH3102 MASS TRANSFER OPERATIONS-II

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 4

Course Objectives:

- Study of the stage wise mass transfer operations, principles of various stage wise contact processes like Distillation, extraction, adsorption, leaching and drying.
- Design aspects of the equipment utilized for the above mentioned operations.
- Attain practical knowledge of separation processes, conduct experiments and submit the report.

Syllabus:

Unit-1
Distillation: Vapor liquid equilibrium, Relative volatility concept, Ideal solutions-Raoult's law: Positive deviation from ideality, Negative deviation from ideality. Enthalpy-concentration diagrams. Azeotropy, Single Stage operation-Flash Distillation, Differential or Simple Distillation: Rayleigh equation. Batch Distillation, Introduction to Fractional Distillation.

Unit-2
Continuous Rectification-Binary system: The method of Ponchon-Savarit andMcCabe-Thiele analysis of binary distillation. Minimum reflux ratio and optimum reflux ratio. Continuous – contact equipment (Packed towers), the transfer unit. Extractive Distillation and Azeotropic Distillation, low pressure distillation and Molecular distillation.

Unit-3
Liquid-Liquid Extraction: Liquid equilibria, Ternary diagram, lever rule, system of three liquids, Choice of solvent. Stage wise contact, single stage extraction, multi-stage cross current extraction, insoluble liquids, continuous countercurrent multi-stage extraction with and without reflux. Stage wise extractors, Sieve tray towers. Differential extractors.

Unit-4
Adsorption and Ion Excahnge: Types and nature of adsorption, adsorption equilibria and isotherms, The Freundlich equation.

Adsorption operation: stage wise, multi stage cross current operation and multi stage countercurrent operation. Continuous adsorption: the adsorption wave, chromatography. Fixed bed adsorption, ion-exchange: principles, techniques and application.

Unit-5

Leaching: Introduction, single and multi-stage operations, countercurrent multiple contact, the shanks system, continuous countercurrent decantation equipment for leaching.

Crystallization: crystal geometry, principles of crystallization equilibria and yields, nucleation, crystal growth, ΔL law, crystallization equipment including MSMPR crystallizers.

Course Outcomes:

- Design calculation of distillation column.
- Separation by adsorption and design of adsorber, chromatographic separation.
- Separation by liquid-liquid Extraction.
- Separation by leaching.

Text Books:

- Mass Transfer Operations, 3rd ed., R. E. Treybal, McGraw-Hill, New York.
- Principles of Mass Transfer and Separation processes, Binary K. Dutta PHI Learning Pvt. Ltd., New Delhi, 2012.

Reference Books:

- Unit operations in chemical engineering, W.L. McCabe and J.C. Smith and Peter Harriott, Mc Graw Hill, 7th ed. 2001.

CH3103 GENERAL CHEMICAL TECHNOLOGY

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Course Objectives:

- Unit operations unit processes involved in manufacture of important and widely employed organic and inorganic chemicals.
- Develop skills in preparing /presenting a neat Engineering drawing for Chemical Process Industries.
- Impart clear description of one latest process along with its Chemistry, Process parameters, Engineering Problems and Optimum Conditions.
- Demonstrate the importance of updating the latest technological developments in producing products economically and environment friendly.
- Appreciate the usage of other engineering principles such as Thermodynamics, heat, mass and momentum transfer in operation and maintain the productivity.

Syllabus:

Unit-1
Introduction to Chemical Technology, Unit Operation, Unit Process & varies Process flow diagrams. Introduction to various symbols & application of unit operations in Process Flow diagrams.

Unit-2
Detailed study of manufacturing process of Inorganic Industry-1- Sulfur and Sulfuric acid Industry, Nitrogen Industry-Ammonia, Nitric acid by ammonia oxidation process, Urea from ammonium carbamate, Ammonium nitrate.

Unit-3
Detailed study of manufacturing process of Inorganic Industry-2-Phosphorus Industry-phosphorus production by electric furnace method, phosphoric acid production by strong acid(H_2SO_4) process & by HCl leaching process, Superphosphate & Triple Superphosphate.

Unit-4
Chlor-Alkali Industries: Manufacture of soda-ash by Solvay process, electrolytic process for chlorine-caustic soda production. Cement Industry.
Detailed study of manufacturing process of Organic Industry-1: Soap, Detergent and Glycerin-continuous process for fatty acids, soap and glycerin.
Sugar and Starch Industry-extraction of sucrose from sugarcane, starch production from maize, production of dextrin by starch hydrolysis.

Unit-5

Paper and Pulp Industry: Sulfate(Kraft) Pulp process-preparation of wood pulp by sulfate process, chemical recovery from sulfate pulp digestion liquor, chemical recovery from neutral pulp digestion liquor. paper making process.

Fermentation Industry-ethyl alcohol by fermentation.

Introduction to Water Gas, Producer Gas ,Natural Gas & Synthesis Gases, Introduction to Petroleum Industry, Introduction to Polymer Industry.

Course Outcomes:

- Ability to understand the manufacturing of various inorganic and organic chemicals.
- Ability to understand the process flow diagram and various process parameters.
- Ability to identify and solve engineering problems during production.

Text books:

1. Shreve's Chemical Process Industries edited by Austin, Mc.graw-Hill.5th ed.1985.
2. Dryden's Outlines of Chemical Technology edited by M. Gopal Rao and M. Sittig, 2nd ed. 1973.

References:

1. Industrial Chemistry by B.K. Sharma,
2. Hand book of industrial chemistry Vol 1& II K.H.Davis & F.S. Berner Edited by S.C. Bhatia, CBS publishers
3. Chemical Technology: G.N. Panday, Vol 1& Vol II.

CH3104 ENVIRONMENTAL POLLUTION AND CONTROL ENGINEERING

(Core Elective-I)

Externals: 60 Marks **L-T-P**

Internals: 40 Marks **3-0-0**

Credits: 3

Course Objective:

The aim of this course is that the students will learn the essential principles used in industrial pollution abatement and pertinent environmental legislations.

Syllabus:

Unit-1

Engineering, ethics and environment. Ecological systems and pollution. Fundamental definitions of pollution parameters – air and water quality criteria, standard and legislation EIA, EIS and EMP. Air and water pollution management through waste minimization.

Unit-2

Industrial air pollution management: Introduction to air pollution, Types and Classification of air pollutants, Concentration measurement of air pollutants, Air pollution effects on monuments-vegetation-Human Health, Air pollution meteorology, industrial plume behavior, types of plumes, Gaussian Plume model, Effective stack height.

Unit-3

Outlines of industrial air pollution control. Section, design and performance analysis of air pollution control equipment, gravity settling chambers, air cyclones, electro-static precipitators, filters and scrubbers.

Unit-4

Industrial water pollution management: Waste water treatment processes: Waste water sampling and analysis- BOD, COD, TDS. Pre-treatment, primary and secondary treatment processes. Advanced waste water treatment processes.

Design of sedimentation tanks and biological treatment processes.

Unit-5

Solid waste management: Collection, storage and transport processing and transformation. Incineration, Composting, sanitary and land filling. Advance solid waste management techniques.

Course outcomes:

- Ability to distinguish between various methods of air pollution analysis.
- To understand air pollution sampling and measurement.
- Water quality analysis and measurement of soil contamination.
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Text Books:

- Environmental pollution and control management, Rao C.S. – Wiley Eastern Limited, India.
- Pollution control in process industries by S.P. Mahajan TMH, 1985.

CHxxx10 **NUCLEAR PROCESS ENGINEERING**
(Core Elective-I)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Course Objectives:
To enable the students to

- Understand radioactivity, nuclear fission and fusion.
- Understand the interaction of alpha, beta particles and neutrons with matter.
- Understand neutron cycle, critical mass, reactor period and transient conditions.
- Understand engineering aspects of nuclear power production and environmental effects.

Syllabus:

Nuclear Energy Fundamentals:
Atomic structure and Radio isotopes, nuclear fission and fusion, types and classification of nuclear reactors, nuclear fuels, other reactor materials, fuel processing flow sheet, chemical processes for nuclear power industries, separation of reactor products, nuclides.

Nuclear Reactions and radiations:
Radioactivity, interaction of alpha and beta particles with matter, decay chains, neutron reactions, fission process, growth and decay of fission products in a reactor with neutron burnout and continuous processing. Make up of reactor, reactor fuel process flow sheet, irradiation schemes, and neutron balance, feed requirements and fuel burn up for completely mixed fuels with no recycle.

Nuclear Reactor theory: The neutron cycle, critical mass, neutron diffusion, the diffusionequation, slowing down of neutrons, reactor period, transient conditions and reflectors.

Engineering Consideration of nuclear Power-Environmental effects:
Introduction to nuclear power systems, Thermal-hydraulics: Thermal parameters: definitions and uses. Sources and distribution of thermal loads in nuclear power reactors. Conservation equations and theirapplications to nuclear power systems: power conversion cycles, containment analysis. Thermal analysis of nuclear fuel, Single-phase flow and heat transfer, Two-phase flow and heat transfer.

Course Outcomes:
At the end of the course, the student will be able to:

- Understand radioactivity, nuclear fission and fusion.
- Understand the interaction of alpha, beta particles and neutrons with matter.
- Understand neutron cycle, critical mass, reactor period and transient conditions.
- Understand engineering aspects of nuclear power production and environmental effects.

Text Books:

1. Glasstone S and AlexenderSeasonske, Nuclear Reactor Engineering, 3rd Edition, CBS publisher, USA, 1994.
2. K. Sriram, Basic Nuclear Engineering, Wiley Eastern Ltd., 1990.
3. W Marshall, Nuclear Power Technology, Vol I, II, and III, Oxford University Press, New York 1983.

CHxxx8 **NANOTECHNOLOGY**

(Core Elective-I)

Externals: 60 Marks **L-T-P**

Internals: 40 Marks **4-0-0**

Credits:3

Course Objectives:

- Basic knowledge of nanotechnology, classification and properties of nanomaterials
- Various methods of synthesis and characterization of nanomaterials
- Applications of nanomaterials

Syllabus:

Unit-1

Introduction: History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges and Future Prospects.

Unit-2

Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials:Dislocations, Twins,stacking faults and voids, Grain Boundaries, triple and disclinations. **Effect of Nano-dimensions on Materials Behavior:** Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, Enhanced solid solubility.

Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties and Mechanical Properties.

Unit-3

Synthesis Routes: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method ,Self assembly,

Top down approaches: Mechanical alloying, Nano-lithography.

Consolidation of Nanopowders: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

Unit-4

Tools to Characterize nanomaterials: X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy

(TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

Unit-5

Applications of Nanomaterials: Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water- Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defence and Space Applications, Concerns and challenges of Nanotechnology.

Course Outcome:

- Understand and apply basic concepts of nanotechnology and nanoscience
- Understand the different nano-materials along with their characterization
- Understand the applications of nanomaterials in Chemical Engineering

Text Books

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

References:

1. Nano:The Essentials , T.Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design, Michael F. Ashby, Paulo J. Ferreira and Daniel L.Schodek
3. Transport in Nano structures, David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S.,S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press

CH3105 NUMERICAL METHODS IN CHEMICAL ENGINEERING
(Core Elective-II)

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-0-0**
Credits: 3	

Course Objectives:
To enable the students to apply the knowledge of Numerical Methods in various engineering fields by making them

- To learn various numerical methods for solving Differential equations.
- To determine the approximate value of the derivative & definite integral for a given data using numerical techniques.
- To introduce the concept of partial differentials and various methods of solving PDEs.
- To learn various methods to solve second order Partial differential equations.

Syllabus:

Unit-1
Introduction, Approximation and Concept of Error and Error Analysis.
Algebraic Equations: Methods like Gauss elimination, LU decomposition and Matrix Inversion, Gauss- Siedel method, Chemical engineering problems involving solution of linear Algebraic equations. Root finding methods for solution on non-linear algebraic equations: Bisection, Newton-Raphson and Secant methods, Chemical engineering problems involving solution of non-linear
Equations

Unit -2
Interpolation and Approximation, Newton's polynomials and Lagrange polynomials, Spline Interpolation, Linear Regression, Polynomial Regression, Least Square Regression

Unit-3
Ordinary Differential Equations: Euler method, Runge-Kutta method, Adaptive Runge-Kutta Method, Initial and boundary value problems, Chemical engineering problems involving single, And a system of ODEs

Unit-4
Introduction to Partial Differential Equations: Characterization of PDEs, Laplace equation, Heat conduction/diffusion equations, Explicit, Implicit, Crank-Nicholson method

Unit-5
Numerical integration: Trapezoidal rule, Simpson’s rule, Integration with unequal segments, Quadrature methods, Chemical engineering problems involving numerical Differentiation and Integration

Course Outcomes:
At the end of the course, the student will be able to:

- To know how root finding techniques can be used to solve practical engineering problems.
- To apply the concept of numerical analysis to find the relative strengths and weaknesses of each computation method and know which are most applicable for given problem.
- To implement integration technique to determine the extreme values of a function.

Text Books:

- Gupta, S. K., "Numerical Methods for Engineers, New Academic Science, 2012.

References Books:

- S.C. Chapra & R.P. Canale, "Numerical Methods for Engineers with Personal Computer Applications", McGraw Hill Book Company, 1985
- R.L. Burden & J. D. Faires, "Numerical Analysis", 7th Ed., Brooks Coles, 2000.
- Atkinson, K. E., "An Introduction to Numerical Analysis", John Wiley & Sons, 1978.
- Press, W. H. et al., "Numerical Recipes in C: The Art of Scientific Computing, 3rd Edition, Cambridge University Press, 2007
- E. Ward Cheney, David R. Kindcaid, Numerical methods and applications, Brooks / core (2008)
- Butcher, J.C 1987, the Numerical analysis of ordinary differential equations, Runge - Kutta and general linear methods. Wiley, Newyork.

CHxxx9 INDUSTRIAL SAFETY AND HAZARD MITIGATION
(Core Elective-II)

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-0-0**
Credits: 3	

Course Objectives:
To enable the students to
- Analyze the effects of release of toxic substances.
- Select the methods of prevention of fires and explosions.
- Understand the methods of hazard identification and preventive measures.
- Assess the risks using fault tree diagram.

Syllabus:

Introduction:
Safety Programs, Engineering Ethics, Accident and Loss Statistics, Acceptable Risk, Public Perceptions, Nature of the Accident Process, Inherent Safety.

Industrial Hygiene:
Anticipation and Identification, Hygiene Evaluation, Hygiene Control.

Fires and Explosions:
Fire Triangle, Distinction between Fires and Explosions, Flammability Characteristics of Liquids and Vapors, Limiting Oxygen Concentration and Inerting, Flammability Diagram.

Concepts to Prevent Fires and Explosions:
Inerting, Controlling Static Electricity, Explosion-Proof Equipment and Instruments, Ventilation, Sprinkler Systems.

Introduction to Reliefs:
Relief Concepts, Location of Reliefs, Relief Types, Relief Scenarios, Data for Sizing Reliefs, Relief Systems.

Relief Sizing-Conventional Spring:
Operated Reliefs in Liquid Service, Conventional Spring-Operated Reliefs in Vapor or Gas Service, Rupture Disc Reliefs in Liquid Service, Rupture Disc Reliefs in Vapor or Gas Service.

Hazards Identification:
Process Hazards Checklists, Hazards Surveys, Hazards and Operability Studies, Safety Reviews.

Safety Procedures and Designs:
Process Safety Hierarchy, Managing Safety, Best Practices, Procedures-Operating, Procedures-Permits, Procedures-Safety Reviews and AccidentInvestigations, Designs for Process Safety.

Course Outcomes:

At the end of the course, the student will be able to:

- Analyze the effects of release of toxic substances.
- Select the methods of prevention of fires and explosions.
- Understand the methods of hazard identification and preventive measures.
- Assess the risks using fault tree diagram.

Text Books:

1. D.A. Crowl and J.F. Louvar, Chemical Process Safety (Fundamentals with Applications), Prentice Hall,2011.
2. R.K. Sinnott, Coulson & Richardson's Chemical Engineering, Vol. 6, Elsevier India, 2006.

CHxxx12 **FERTILIZER TECHNOLOGY**

(Core Elective-II)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Course Objectives:
To enable the students to

- Classify fertilizers
- Explain manufacturing processes involved in production of fertilizers.
- Identify the effect of technologies on the health, safety and environment.
- State the chemical reactions and their mechanism involved.

Syllabus:

Introduction:
Elements required for plants growth, Classification of fertilizers, Compound, Complex and bulk blended fertilizers. N-P-K values and calculations.

Nitrogenous Fertilizers:
Manufacturing Processes for Ammonia, Manufacture of ammoniumsulphate, ammonium chloride, Ammonium phosphate, Ammonium nitrate, nitric acid, Urea etc. Economics and other strategies, Material of construction and corrosion problem.

Phosphatic fertilizers:
Calculation of percentage tricalcium phosphate of lime in phosphatic rock: Manufacture of triple super phosphate and single super phosphate, Nitro phosphate, Sodium phosphate, phosphoric acid and other phosphatic fertilizers.

Potash Fertilizers:
Manufacture of potash fertilizers like potassium sulphate, potassium chloride etc.

Course Outcomes:
At the end of the course, the student will be able to:

- Classify fertilizers
- Explain manufacturing processes involved in production of fertilizers.
- Identify the effect of technologies on the health, safety and environment.
- State the chemical reactions and their mechanism involved.

Text Books:

1. SittigMandGopalaRao M., Dryden's Outlines of Chemical Technology for the 21st Century, 3rd Edition, WEP East West Press, 2010.
2. Austin G T., Shreve's Chemical Process Industries, McGraw Hill Book Company, New Delhi, 5th Edition, 1986.
3. Shukla S D and Pandey G N, A Text Book of Chemical Technology, Vol I &II, Vikas Publishing House Pvt. Ltd., New Delhi, 2000.

MC210x **CONSTITUTION OF INDIA**
(MC-II)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 0

Course Objectives:

- Sensitization of student towards self, family (relationship), society and nature.
- Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
- Strengthening of self reflection.
- Development of commitment and courage to act.

Syllabus:

Unit-1
Constitution of India – Basic features and fundamental principles:
Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India, Salient features and characteristics of the Constitution of India, Scheme of the fundamental rights, The scheme of the Fundamental Duties and its legal status, The Directive Principles of State Policy – Its importance and implementation, Federal structure and distribution of legislative and financial powers between the Union and the States, Parliamentary Form of Government in India – The constitution powers and status of the President of India, Amendment of the Constitutional Powers and Procedure, The historical perspectives of the constitutional amendments in India, Emergency Provisions : National Emergency, President Rule, Financial Emergency, Local Self Government – Constitutional Scheme in India, Scheme of the Fundamental Right to Equality, Scheme of the Fundamental Right to certain Freedom under Article 19, Scope of the Right to Life and Personal Liberty under Article 21.

Unit-2
Universal Human Values – 1

Unit-3
Environment Science

Unit-4
Essence of Indian Knowledge Tradition

Unit-5
Learning an Art Form (Music: vocal or instrumental, dance, painting, clay modeling, etc.)

Course outcomes:

- At the end of the course, students are expected to become more aware of their surroundings, society, social problems and their sustainable solutions, while keeping human relationships and human nature in mind.
- They would have better critical ability. They would also become sensitive to their commitment towards what they believe in (humane values. humane relationships and humane society).
- It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

MC210x ESSENCE OF INDIAN KNOWLEDGE TRADITION (MC-II)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 0

ESSENCE OF INDIAN KNOWLEDGE TRADITION-Pt-1

भारतीयविद्यासार - 1

Course Objective

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course contents

- Basic Structure of Indian Knowledge System: अष्टादश विद्या – ४ वेद, ४ उपवेद (आयुर्वेद, धनुर्वेद, गान्धर्व वेद, स्थापत्य आदि), ६ वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद), ४उपाङ्ग (धर्म शास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health Care
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India – course material*, BharatiyaVidyaBhavan, Mumbai,5th Edition, 2014
- Swami Jitatmanand, *Modern Physics and Vedant*, BharatiyaVidyaBhavan.
- Swami Jitatmanand, *Holistic Science and Vedant*, BharatiyaVidyaBhavan.
- Fritzof Capra, *Tao of Physics*.
- Fritzof Capra, *The Wave of Life*.
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkatta.
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, VidyanidhiPrakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapy and Yoga Practices*, VidyanidhiPrakashan, Delhi 2016
- P B sharma (English translation), *ShodashangHridayam*

Pedagogy: Problem based learning, group discussions, collaborative mini projects

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledgein modern scientific perspective.

ESSENCE OF INDIAN KNOWLEDGE TRADITION – Pt-2

भारतीयविद्यासार - 2

Course Objective

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-2 focuses on Indian philosophical traditions, Indian linguistic Tradition, and Indian artistic tradition.

Course contents

- Philosophical Tradition(सर्वदर्शन) – न्याय, वैशेषिक, सांख्य, योग, मीमांसा, वेदान्त, चार्वाक, जैन, बौद्ध
- Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)
- Indian Artistic Tradition –चित्रकला, मूर्तिकला, वास्तुकला,स्थापत्य, संगीत, नृत्यएवंसाहित्य
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India – course material*, BharatiyaVidyaBhavan, Mumbai,5th Edition, 2014
- S.C.Chaterjee&D.M.Datta, *An Introduction to Indian Philosophy*,University of Calcutta, 1984
- KS SubrahmaniaIyer, *Vakyapadiya of Bhartrihari, (Brahma Kanda)*, Deccan College Pune 1965
- *Panini Shiksha*, MotilalBanarasidas
- VN Jha, *Language, Thought and Reality*.
- वासुदेवशरणअग्रवाल, कलाएवंसंस्कृति, साहित्यभवन, इलाहाबाद, 1952
- Pramod Chandra, *India Arts*, Howard Univ. Press, 1983
- Krishna Chaitanya, *Arts of India*, Abhinav Publications, 1987
- R Nagaswamy, *Foundations of Indian Art*, Tamil Arts Academy, 2002

Pedagogy: Problem based learning, group discussions, collaborative mini projects

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledgein modern scientific perspective.

ESSENCE OF INDIAN KNOWLEDGE TRADITION – Pt-2

भारतीयविद्यासार - 2

[illegible]

Course Objective

- The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-2 focuses on Indian philosophical traditions, Indian linguistic Tradition, and Indian artistic tradition.

Course contents

- Philosophical Tradition(सर्वदर्शन) – न्याय, वैशेषिक, सांख्य, योग, मीमांसा, वेदान्त, चार्वाक,जैन, बौद्ध
- Indian Linguistic Tradition (Phonology, morphology, syntax and semantics)
- Indian Artistic Tradition –चित्रकला, मूर्तिकला, वास्तुकला,स्थापत्य, संगीत, नृत्यएवंसाहित्य
- Case studies

References

- V. Sivaramakrishnan [Ed.], *Cultural Heritage of India – course material*, BharatiyaVidyaBhavan, Mumbai.5th Edition, 2014
- S.C.Chaterjee&D.M.Datta, *An Introduction to Indian Philosophy*,University of Calcutta, 1984
- KS Subrahmanialyer, *Vakyapadiya of Bhartrihari, (Brahma Kanda)*, Deccan College Pune 1965
- *Panini Shiksha*, MotilalBanarasidas
- VN Jha, *Language, Thought and Reality*.
- वासुदेवशरणअग्रवाल, कलाएवंसंस्कृति, साहित्यभवन, इलाहाबाद, 1952
- Pramod Chandra, *India Arts*, Howard Univ. Press, 1983
- Krishna Chaitanya, *Arts of India*, Abhinav Publications, 1987
- R Nagaswamy, *Foundations of Indian Art*, Tamil Arts Academy, 2002

Pedagogy: Problem based learning, group discussions, collaborative mini projects

Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledgein modern scientific perspective.

CH3106 MASS TRANSFER OPERATIONS LABORATORY

Externals: 60 Marks **L-T-P**

Internals: 40 Marks **0-0-3**

Credits: 1.5

Course Objectives:

This lab gives an overall idea of various mass transfer operations used in the industry.

List of experiments:

- To study the performance of a bench top cooling tower
- Solid liquid extraction
- Absorption
- Adsorption
- The drying curve of a solid under constant drying conditions
- Separation of two miscible liquids in a sieve plate distillation column
- Liquid-liquid extraction
- Estimation of binary gas diffusivity
- Packed bed distillation column
- Simple distillation
- Steam Distillation.

Course Outcomes:

- To demonstrate an understanding of heat and mass transfer modes and models
- To formulate the idea of the different types of interface reactions
- To apply principles of heat and mass transfer phenomena to chemical process industries
- To enable solving the problems on process and materials related combined heat and mass transfer phenomena.

CH3107 CHEMICAL ENGINEERING ANALYTICAL LABORATORY

Externals: 60Marks **L-T-P**

Internals: 40Marks **0-0-3**

Credits: 1.5

Course Objective:

This lab gives an over view of estimation of various parameters for treatment of ground water, surface and waste water. And also gives clear clarity about analysis of air, coal, petroleum products and solid fuels.

List of Experiments:

1. Estimation of chemical and physical parameters of Ground and Surface water:
   P^H, TDS & Conductivity, Hardness, Turbidity, Fluoride, Color analysis.
   Pesticide Microbial analysis: e-coli/ total coli forms bacteria
2. Estimation of physical parameters of waste water:
   P^H, TDS, Hardness, Turbidity, Alkalinity etc.
3. Estimation of chemical parameters of waste water:
   COD, BOD, TSS
4. Water and waste water treatment:
   Small RO system for treatment of ground water.
   Same above system with UF membrane for turbidity removal and water disinfection.
5. Analysis of Air:
   Estimation of SPM, RSPM, Sox, Nox, CO and ozone in atmospheric air to study air pollution.
   Fuel cell Test Kit [Energy]
   A small ½ watt to 1 watt fuel cell with water electrolysis kit (H_2 and O_2 Generation) plus small voltmeter and ammeter for measuring fuel cell performance.
7. Measurement of Flash point, fire point and calorific value of petroleum products.
8. Proximate Analysis of Coal – Moisture, Volatile Matter, Fixed Carbon and Ash. (Hot air Oven & Muffle Furnace)
9. Calorific value of Solid Fuels.
10. Energy auditing of your Department.

List of Equipment

P^H meter, Colorimeter, TDS meter, Aerobic /Anaerobic reactor 25L capacity, BOD incubator, High accuracy analytical balance (5 digit), Desiccators, RO system with domestic 2''x12'' Membrane module, H_2S vial kit, Water analysis kit, UV-Vis spectrophotometer, High volume air sampler, Bomb calorimeter, Fuel cell test kit, Microscope.

Course Outcome:

- To know about the conventional energy resources and their effective utilization
- To acquire the knowledge of modern energy conversion technologies
- To be able to understand and perform the various characterization techniques of fuels
- To be able to identify available non-conventional (renewable) energy resources and Techniques to utilize them effectively

CH2105 SEMINAR-II

Externals: 100 Marks **L-T-P 0-0-0**

Credits: 1

Course Objectives:

- To improve the presentation skills
- To prepare PPT more effectively

Course Outcomes:

- Student will better understand the role that effective presentations have in public/professional contexts and gain experience in formal/ informal presentation.
- Student has to choose a general Chemical Engineering topic to give a power point presentation

THIRD YEAR (E3) SEMESTER-II

S.NO.	Code	Course title	Category	Hours per week			Credits
				Lectu re	Tutorial	Practical	
1	CH3201	Chemical Reaction Engineering-II	PCC	3	1	0	4
2	CH3202	Instrumentation& Process Control	PCC	3	1	0	4
3	CH3203	Core Elective-III	PCE	3	0	0	3
4	CHxxx	Open Elective-I	OEC	3	0	0	3
5	HS320x	HASS-IV	HSMC	3	0	0	3
6	CH3204	Chemical Reaction Engineering Laboratory	PCC	0	0	3	1.5
7	CH3205	Instrumentation& Process Control Laboratory	PCC	0	0	3	1.5
8	CH3206	Comprehensive Viva-I	SIP	0	0	0	1
9	CH3207	Internship (6 to 8weeks)	SIP	0	0	0	3
						TOTAL	24

Core Elective-III:

1. Plant design & Economics (PDE)
2. Membrane Technology
3. Novel Separation Process

Open Elective-I:

1. Polymer Science and Engineering
2. Renewable Energy sources
3. Fuel Cell Engineering

HASS-IV: 1. History of Science and technology in India
2. Human Relations at work

CH3201 CHEMICAL REACTION ENGINEERING-II

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-1-0**
Credits: 4	

Course Objectives:

- Learn to characterize and diagnose the non-ideal reactors. Learn the modeling of Non-ideal flow reacting vessels.
- Calculate the conversions in non-ideal reactor using various flow models.
- Understand the concepts in heterogeneous reaction systems. Determine the rate controlling step in catalytic reactions. Understand the internal and external diffusion effects.
- Learn the factors influencing catalyst decay, the role of pore diffusion on catalyst activity rate.
- Learn the kinetics and reactor design of various heterogeneous reaction systems

Syllabus:

Unit-1

Non-Ideal Flow: Basics of Non-Ideal Flow; E, the age distribution of fluid, the RTD, Pulse Response Experiments, Conversion in Non-Ideal flow reactors, Compartment Models.

Unit-2

The Dispersion Model-Axial Dispersion, Correlations for Axial Dispersion, Chemical Reaction and Dispersion.

The Tanks-in-series Model- RTD, Chemical Conversion.

Unit-3

The Convection Model for Laminar Flow: The Pure Convection Model and its RTD, Chemical Conversion in Laminar Flow reactors.

Earliness of Mixing, Late mixing, Segregation and RTD, Self Mixing of a single fluid, Mixing of two miscible fluids.

Unit-4

Reactions Catalyzed by solids: Heterogeneous Reactions-Introduction, Solid Catalyzed Reactions, The Rate Equation For surface Kinetics, Pore diffusion resistance combined with surface kinetics, porous catalyst particles, Heat effects during reaction, Performance equations for reactors containing porous catalyst particles, Experimental methods for finding rates. Rate-Controlling Step.

Various types of fixed bed reactors and fluidized bed reactors.
Deactivating Catalysts-Mechanisms of Catalyst deactivation, rate and performance equation.

Unit-5

Non-Catalytic Systems, Fluid-Fluid Reaction Kinetics, Fluid-Fluid reactor design, Fluid-Particle Reaction Kinetics-Selection of a model, Shrinking Core Model for spherical particles of unchanging size, Rate of reaction for shrinking spherical particles and Rate-Controlling Step.

Course Outcomes:

- Ability to distinguish between various RTD curves and predict the conversion from a non-ideal reactor using tracer information.
- Develop rate laws for heterogeneous reactions
- Design of reactors for non-catalytic and catalytic reactions.
- Design of towers for gas–liquid operations with and without chemical reaction.

Text Books:

- Chemical Reaction Engineering, Octave Levenspiel, 3rd Edition, John Wiley & Sons India Edition.

Reference Books:

- Elements of Chemical Reaction Engineering, Scott Fogler. H, 4th Edition. PHI
- The Engineering of Chemical Reactions, 2nd ed., L.D. Schmidt, Oxford University Press, New Delhi, 2010

CH3202 INSTRUMENTATION AND PROCESS CONTROL

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-1-0**
Credits: 4	

Course Objectives:

- Develop mathematical and transfer function models for dynamic processes.
- Analyze and characterize different process.
- Analyze process stability and dynamic responses.
- Empirically determine process dynamics for step response data.
- Development of block diagrams, reading block diagrams, process and instrumentation diagrams.
- Familiarity with different types of feedback controllers.
- Develop different advanced control strategies.
- Knowledge of real time applications of process control implementation.
- Knowledge and working principles of different instruments used in Industry.

Syllabus:

Unit 1

Mathematical Modeling, Development of mathematical models, modeling considerations for control purposes. Dynamic Behavior of Chemical Processes, Brief of Laplace transforms.

Unit 2

Transfer functions and the input-output models, Dynamics and analysis of first, second and higher order systems- Multiple capacitance systems, Dead time, Inverse Response.

Unit 3

Feedback Control Schemes, Concept of feedback control, Dynamics and analysis of feedback-controlled processes, Stability analysis- Routh Hurwitz criterion, Root Locus analysis, Controller design- control valve characteristics.

Unit 4

Frequency response analysis-Bode plots, polar plots Bode stability criterion, controller tuning. Advanced Schemes- Dead time compensator, Inverse response compensator, Cascade controller, Split range controller, Over-ride controller and Feed forward controller.

Unit 5

Characteristics Of Measurement System, Pressure Measurement, Temperature Measurement, Flow Measurement, Measurement-Instruments For Analysis. Introduction to Digital control.

Course Outcomes:

- Knowledge of field instrumentations.
- Dynamic modeling and system behavior study.
- Design of controllers.
- Application of control systems in processes and Knowledge of field instrumentations.

Text Books:

1. Principles of Industrial Instrumentation, Patranabis D- 2nd Edition - Tata McGraw Hill Publishing Company, New Delhi (1999)
2. Chemical process control by G. Stephanopolous, PHI,1998

References Books

1. Industrial instrumentation by Donald P. Eckman, Wiley eastern.
2. Process systems analysis and control by D.R. Coughanowr, 2nd ed. Mc Graw Hill
3. Process Control by Wayne Bequette, PHI.

CH3203 PLANT DESIGN AND ECONOMICS

(Core Elective-III)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-1-0**
Credits: 3

Syllabus:

Unit-1

Introduction to plant design. Process design development: Design project procedure, design information from the literature, flow diagrams, preliminary design, comparison of different processes, equipment design, scale-up in design, safety factors, specifications.

Unit-2:

General design considerations: Health and safety hazards, fire and explosion hazards, plant location, plant layout, plant operation and control, utilities, structural design, storage, materials handling.

Materials and fabrication selection: Materials of construction, selection of materials, fabrication of equipment.

Unit-3

Mechanical design of process equipment:

Pressure vessels: Calculation of thickness of cylindrical and spherical, Storage vessels – storage of nonvolatile liquids, storage of volatile liquids, storage of gases. Supports for vessels – bracket or lug supports, leg supports, skirt supports, saddle supports.

Heat and Mass transfer equipment design

Unit-4

Cost and Asset accounting: Basic relations in accounting, the balance Sheet, the income statement. Cost estimation: Capital investments, types and methods for estimating capital investment. Cost Indexes. Cost factors in capital investment: six-tenth factor rule.

Interest and Investment Costs: Simple Interest, Compound Interest, Continuous Interest, Present worth and Discount, Annuities, Perpetuities and Capitalized costs.

Taxes and insurances, type of taxes: federal income taxes, insurance-types of insurance, self-insurance.

Depreciation: Types of depreciation, service life, salvage value, present value, methods for determining depreciation, single unit and group depreciation.

Unit-5

Profitability analysis: rate of return on discounted cash flow, net present value (NPV), payback period. Annual cost method, present worth method, equivalent alternatives, rate of return method, payout time method, effect of source of capital, replacement of existing facilities.
Optimum Design and Design Strategy, Break even chart.

Text Books:

1. Chemical Engineering Vol. VI (An introduction to Chemical Engineering Design), Coulson J.M. and Richardson J.F Pergamon Press, 1993.
2. Process Equipment Design, M. V. Joshi, 3rd Edition, Macmillan India Limited 2003.
3. Peters Max. S., Timmerhaus Klaus D.and Ronald E West "Plant Design and Economics for Chemical Engineers".2003 5th Edition McGraw Hill.
4. Chemical Engineering Plant Design, C. Vilbrandt and Dryden C.E. 4th Edition, McGraw Hill Book Co., 1959.

References:

1. Process Plant Design, Backhurst, J.R And Harker, J. H, Heieman Educational Books, London (1973).
2. Process Engineering Economics, H.E. Schweyer, McGraw Hill Co., New York, Kogakusha Co., Ltd., Tokyo. 1955.

Chxxx13 **MEMBRANE TECHNOLOGY**
(Core Elective-III)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Course Objectives:
To enable the students to
- Understand the technologies of membrane synthesis
- Classify the membranes
- Select membrane according to the application.
- Understand the mathematical models of membrane processes.

Syllabus:

Introduction:
Membrane separation process, Definition of Membrane, Membrane types, Advantages and limitations of membrane technology compared to other separation processes, Membrane materials.

Preparation of synthetic membranes:
Phase inversion membranes, Preparation techniques for immersion precipitation, Synthesis of asymmetric and composite membranes, and Synthesis of inorganic membranes.

Transport in membranes:
Introduction, Driving forces, Transport through porous membranes, transport through non-porous membranes, Transport through ion-exchange membranes.

Membrane processes:
Pressure driven membrane processes, Concentration as driving force, electrically driven membrane processes.

Polarisation phenomena and fouling:
Concentration polarization, Membrane fouling.

Modules:
Introduction, membrane modules, Comparison of the module configuration

Course Outcomes:
At the end of the course, the student will be able to:
- Understand the technologies of membrane synthesis
- Classify the membranes
- Select membrane according to the application.
- Understand the mathematical models of membrane processes.

Text Books:

1. Mulder M, Basic Principles of Membrane Technology, Kluwer Academic Publishers, London, 1996.
2. Richard W. Baker, Membrane Technology and Research, Inc. (MTR), Newark, California, USA, 2004.
3. Kaushik Nath, Membrane Separation Processes, Prentice-Hall Publications, New Delhi, 2008.

CHxxx3 NOVEL SEPARATION PROCESSES

(Core Elective-III)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **4-0-0**

Course Objectives:

- To acquaint the student with all the separation process and their applications.

Syllabus:

Unit 1

Rate governed processes: definitions and terminologies

Unit 2

Membrane separation processes, preparation and characterization of membranes. Principles of reverse osmosis, nano-filtration, ultra filtration, microfiltration. Osmotic Controlled Filtration, Gel Layer Filtration

Unit 3

Detailed design and modeling: film theory, similarity solution, integral method, Design of membrane/process modules; Basic principles and modeling of dialysis

Unit 4

Electric field enhanced separation processes: zeta potential, electric double layer; Basic modeling of electric field enhanced filtration

Unit 5

Liquid membrane and its modeling, Basic design of gas separation and pervaporation.

Course Outcomes:

- Learn fundamentals of membrane separation processes and current market scenario
- Classify and characterize membrane separation processes
- Principles and methodologies of separation and transport of molecules through membrane
- Learn latest development in both theory and applications
- Working out solutions to exercise problems through tutorials
- Complete process design of separation through assignment / group task

Text books:

1. Handbook of Separation Process Technology, R W Rousseau (John Wiley & Sons).
2. Supercritical Fluid Extraction, M A Mchugh & V J Krukonis (Butterworth Heinmann).
3. Large Scale Adsorption & Chromatography, W C Wankat (CRC Press Inc).
4. Advanced Membrane Technology and Applications, N N Li (Wiley).

References:

1. Synthetic Membranes : Science, Engineering and Applications, Eds., P. B. Bunge, H. K. Lonsdale and M. N. dePinho.

CHxxx4 **POLYMER SCIENCE AND ENGINEERING**

(Open Elective-I)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **4-0-0**
Credits:3
Course Objective:

- To enable the students to compute molecular weight averages from the molecular weight distribution, Condensation polymerization and transition in polymers
- To learn about polymerization reaction kinetics
- To learn about Reactor design for polymeric systems
- To understand rheological behavior of polymeric systems.
- Understand the unit operations in polymer industries

Syllabus:

Unit-1
Introduction; definitions: polymer& macro molecule, monomer, functionality, average functionality, co-polymer, polymer blend., plastic and resin. Classification of polymers: based on source, structure, applications, thermal behavior, mode of polymerization. Concept of average molecular weight of polymers, molecular weight distribution, poly disparity index. Determination of average molecular weights: End group analysis, osmometry, light scattering techniques, viscometer, Gel permeation chromatography.

Unit-2
Natural polymers: brief study of i) Natural rubber ii) shellac iii) rosin iv) cellulose v) proteins.
Mechanism and kinetics of: Addition or chain polymerization
a) Free radical addition polymerization b) Ionic addition polymerizations
c) Coordination polymerization d) Coordination or step growth or condensation polymerization.
Unit-3
Methods of polymerization: mass or bulk polymerization process, solution polymerization process, suspension polymerization process and emulsion polymerization method comparison of merits and demerits of these methods. Properties of polymers: crystalline and amorphous status, melting and glass transition temperatures and their determination, effect of polymer structure on mechanical, physical, chemical and thermal properties.

Unit-4
Degradation of polymers, Role of the additives in the polymers: Fillers and reinforcing fillers; Plasticizers; Lubricants; Antioxidants and UV stabilizers; Blowing agents; Coupling agents ; Flame retardants; Inhibitors

Brief description of manufacture, properties and uses of: Polyethylene (HDPE&LDPE); Poly propylene; Polyvinylchloride; Polystyrene; Polytetra fluoroethylene; Polyesters; Nylon(Nylon 66) ; Phenol- Formaldehyde resins; Epoxy resins; Polyurethane; Silicones

Unit-5
Reactors for polymerization; Rheology of polymeric system.
Compounding of polymer resins, brief description of: i) Compression and transfer moulding ii) Injection moulding iii) Extrusion iv) Blow moulding v) Calendaring vi) Laminating and pultrusion.

Course Outcomes:
- Understand the structure-processing-property relationship of polymers.
- Understand the techniques and their characteristics/limitations of synthesis of polymers.
- Understand and apply the various processing and manufacturing techniques.
- Understand the basic issues involved in polymer blends, composites and nanocomposites.

Text Books:
1. Polymer Science & Technology, 2nd ed., J.R. Fried, PHI Learning Pvt. Ltd., New Delhi, 2009
2. Plastic materials, J.A. Brydson, Newnes-Butterworth (London) 1989.
3. Polymer science by VR Gowariker, New age international limited, India

References:
1. Text book of polymer science, F.W.Jr. Bill Meyer, (3rd ed.) John Wiely&sons 1984
2. Introduction to Plastics, J.H. Brison and C.C. Gosselin, Newnes-Butterworth, London 1968.

CHxxx11 **RENEWABLE ENERGY SOURCES**
(Open Elective-I)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Course Objectives:
To enable the students to
- Describe the challenges and problems associated with the use of energy sources.
- List renewable energy resources and technologies.
- Design conversion technologies for solar, wind, biomass and hydrogen energies.
- Evaluate the performance of energy conversion technologies.

Syllabus:

Sources of energy:
Energy sources and their availability, renewable energy sources.

Energy from Biomass:
Introduction, Biomass as a source of energy, Biomass conversion technologies, Biogas generation, classification of biogas plants, Biomass gasification.

Solar Energy:
Sun and solar energy, solar radiation and its measurement, solar energy collectors, solar energy storage, Photovoltaic systems, Application of solar energy.

Wind Energy:
Wind as an Energy source, Basic principles of wind energy conversion, Types of Wind machines, Components of wind energy conversion system, Performance of wind machines, Application of wind energy.

Geothermal Energy:
Introduction, Origin and distribution of geothermal energy, types of geothermal resources, Hybrid geothermal power plant, Application of geothermal energy

Hydrogen energy:
Introduction, Hydrogen production, Hydrogen storage, Hydrogen transportation.

Energy from the Oceans:
Introduction, Ocean Thermal Electric Conversion (OTEC), Energy from Tides, Ocean Waves.

Chemical Energy Sources:
Introduction, Fuel cells, Batteries.

Course Outcomes:

At the end of the course, the student will be able to:

- Describe the challenges and problems associated with the use of energy sources.
- List renewable energy resources and technologies.
- Design conversion technologies for solar, wind, biomass and hydrogen energies.
- Evaluate the performance of energy conversion technologies.

Text Books:

1. Rai, G.D, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 2010.
2. Rajesh Kumar Prasad, T.P. Ojha, Non-Conventional Energy Sources, Jain Brothers, 2012.
3. Sukhatme S.P and J. Nayak, Solar energy – Thermal Collection and storage, 3rd Edition, Tata McGraw Hill Education Pvt Ltd., 2008.
4. MM. EI – Wakil, Power Plant Technology, Tata McGraw Hill, NewYork, 1999.

CHxxx11 **FUEL CELL ENGINEERING**
(Open Elective-I)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Course Objectives:

Syllabus:

Unit-1:
Overview of Fuel Cells: What is a fuel cell, brief history, classification, how does it work, why do we need fuel cells, Fuel cell basic chemistry and thermodynamics, heat of reaction, theoretical electrical work and potential, theoretical fuel cell efficiency.

Unit-2:
Fuels for Fuel Cells: Hydrogen, Hydrocarbon fuels, effect of impurities such as CO, S and others.

Unit-3:
Fuel cell electrochemistry: electrode kinetics, types of voltage losses, polarization curve, fuel cell efficiency, Tafel equation, exchange currents.

Unit-4:
Fuel cell process design: Main PEM fuel cell components, materials, properties and processes: membrane, electrode, gas diffusion layer, bi-polar plates, Fuel cell operating conditions: pressure, temperature, flow rates, humidity.
Main components of solid-oxide fuel cells, Cell stack and designs, Electrode polarization, testing of electrodes, cells and short stacks, Cell, stack and system modeling

Unit-5:
Fuel processing: Direct and in-direct internal reforming, Reformation of hydrocarbons by steam, CO_2 and partial oxidation, Direct electro-catalytic oxidation of hydrocarbons, carbon decomposition, Sulphur tolerance and removal, Using renewable fuels for SOFCs

Course Outcome:
- Understand fuel cell fundamentals.
- Analyze the performance of fuel cell systems.
- Understand construction and operation of fuel cell stack and fuel cell system.
- Apply the modeling techniques for fuel cell systems.

Text books:
1. Hoogers G., Fuel Cell Technology Hand Book, CRC Press, 2003.

2. Karl Kordesch& Gunter Simader, Fuel Cells and Their Applications, VCH Publishers, NY, 2001.
3. F. Barbir, PEM Fuel Cells: Theory and Practice, 2nd Ed., Elsevier/Academic Press, 2013.
4. Subhash C. Singal and Kevin Kendall, High Temperature Fuel Cells: Fundamentals, Design and Applications, 2003.
5. O'Hayre, R. P., S. Cha, W. Colella, F. B. Prinz, Fuel Cell Fundamentals, Wiley, NY 2006.

CHxxx11 **HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA**

(HASS-IV)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **3-0-0**
Credits: 3

Syllabus:

Unit-1
Concepts and Perspectives: Meaning of History, Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history, Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation verses evidence, concept of historical inevitability, Historical Positivism.
Science and Technology: Meaning, Scope and Importance, Interaction of science, technology & society, Sources of history on science and technology in India.

Unit-2
Historiography of Science and Technology in India: Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

Unit-3
Science and Technology in Ancient India: Technology in pre-historic period, Beginning of agriculture and its impact on technology, Science and Technology during Vedic and Later Vedic times, Science and technology from 1st century AD to C-1200.

Unit-4
Science and Technology in Medieval India: Legacy of technology in Medieval India, Interactions with Arabs, Development in medical knowledge, interaction between Unani and Ayurveda and alchemy, Astronomy and Mathematics: interaction with Arabic Sciences, Science and Technology on the eve of British conquest.

Unit-5
Science and Technology in Colonial India: Science and the Empire, Indian response to Western Science, Growth of techno-scientific institutions.

Unit-6
Science and Technology in a Post-Independent India: Science, Technology and Development discourse, Shaping of the Science and Technology Policy, Developments in the field of Science and Technology, Science and technology in globalizing India, Social implications of new technologies like the Information Technology and Biotechnology.

CHxxx11 **HUMAN RELATIONS AT WORK**

(HASS-IV)

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**3-0-0**
Credits: 3	

Course Objectives: The objectives of this course are to make students:

- Aware of human relations at work its relationship with self.
- Aware about the processes involved in interaction with people at work.
- Understand the importance of psychological and physical health in maintaining human relations at work and progressing in career.

Syllabus:

Unit-1

Understanding and Managing Yourself: Human Relations and You, Self-Esteem and Self-Confidence, Self-Motivation and Goal Setting, Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

Syllabus:

Unit II

Dealing Effectively with People: Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

Unit -III

Staying Physically Healthy: Yoga, Pranayam and Exercise: Aerobic and anaerobic.

Unit-IV

Staying Psychologically Healthy: Managing Stress and Personal Problems, Meditation.

Unit-V

Developing Career Thrust: Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, Developing Good Work Habits.

Text Books:

- Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications, and Skills, 11th Ed. Upper Saddle River, NJ: Pearson.

Reference Books:

- Greenberg, J. S. (2017). Comprehensive stress management (14th edition). New York: McGraw Hill.
- Udai, Y. (2015). Yogasan aur pranayam. New Delhi: N.S. Publications.

CH3204 CHEMICAL REACTION ENGINEERING LAB

Externals: 60Marks	**L-T-P**
Internals: 40Marks	**0-0-3**

Credits:1.5

Course Objectives:

- Operate lab equipments like CSTR, Batch, PFR reactors.
- Analyze the concentration versus time data and determine the specific rate constant and the order of the reaction.
- Compare theoretical and experimental conversions in a CSTR and PFR.
- Estimate RTD and model parameters in a CSTR, PFR, packed bed and CSTRin-series.

Course Outcomes:

- Design the experiments to acquire the kinetic and RTD data.
- Analyze the experimental data to obtain the reaction rate expression (reaction order and specific reaction rate constant).
- Attain competency in running the bench scale and pilot scale reactors.

List of Experiments:

1. To determine the specific reaction rate constant of a reaction of a known order using a batch reactor
2. To determine the specific reaction rate constant of a reaction of a known order using a CSTR.
3. Determination of the activation energy of a reaction using a Batch reactor, CSTR
4. To determine the order of the reaction and the rate constant using a tubular reactor.
5. CSTRs in series- comparison of experimental and theoretical values for space times and volumes of reactors.
6. Mass transfer with chemical reaction (solid-liquid system)
7. RTD in tubular reactor
8. RTD in Mixed flow reactor.
9. Study catalytic reaction

CH3205 INSTRUMENTATION AND PROCESS CONTROL LAB

Externals: 60Marks	**L-T-P**
Internals: 40Marks	**0-0-3**
Credits: 1.5	

Course Objectives:

- To evaluate response of fist and higher order characteristics.
- Study the installed characteristics of the valve.
- Study if there is a hysteresis in the control valve and sensor.
- Evaluate the tuning of a PID control via manual and automatic tuning.
- Evaluate the effect controller on the control system

Course Outcomes:

- To measure the steady state response and dynamic response of a process system
- To compare the responses with those obtained from the mathematical model
- To validate the methods for closed-loop stability analysis in context to a practical controller
- To validate the controller tuning methods in context to a practical controller.

List of Experiments

1. Study of Flow control trainer
2. Study of Level control trainer
3. Study of Pressure control trainer
4. Study of Temperature control trainer
5. Control valve characterization
6. Characterization of thermocouples
7. Study of Flapper nozzle
8. Differential pressure transmitter
9. Study of I/P and P/I Converter
10. Interacting and Non interacting system

CH3206 Comprehensive Viva-I

Externals: 100 Marks **L-T-P**

Credits: 1 **0-0-0**

Course Objectives:

- To test knowledge of the student in core subjects covered upto the end of third year of engineering
- To prepare the student to face technical interview.

Student has to appear before a panel of department faculty to test his knowledge/skills acquired in core departmental subjects.

Course Outcome:

Viva voce will be conducted towards the end of the semester which will be covering the complete syllabus. This will test the student's learning and understanding during the course of their under graduate program. In doing so, the main objective of this course is to prepare the students to face interview both at the academic and the industrial sector.

CH3207 SUMMER INTERNSHIP

External Advisor: 30 Marks
Department Assessment: 70 Marks
Credits: 2

Course Objective:

- To get industrial /research experience

Every student must do 8 weeks of Summer Internship after E3-Sem2 Examination. The evaluation of Summer Internship will be done in the beginning of E4-Sem1.

Course Outcome:

Students will verbally express ideas clearly and persuasively with clients, supervisors and colleagues and will participate effectively in discussion.

FOURTH YEAR (E4) SEMESTER-I

S.NO.		Course title	Category	Hours per week			Credits
				Lecture	Tutorial	Practical	
1	CH4101	Process Modeling and Simulation	PCC	3	0	0	3
2	CH4102	Transport Phenomena	PCC	3	1	0	4
3	CHxxx	Core Elective-IV	PCE	3	0	0	3
4	CHxxx	Open Elective-II	OEC	3	0	0	3
5	CHxxx	Open Elective-III	OEC	3	0	0	3
6	CH4103	Design and Simulation lab	PCC	0	0	3	1.5
7	CH4104	PMS Lab	PCC	0	0	3	1.5
						TOTAL	19

Core Elective-IV:

1. Petroleum Engineering
2. Bio-Chemical Engineering
3. Instrumental Methods in Chemical Analysis

Open Elective-II:

1. Computational Fluid Dynamics
2. Green Technology
3. Water and Waste water Treatment

Open Elective-III:

1. Fluidization Engineering
2. Corrosion Engineering
3. Mineral Processing Engineering

CH4101 PROCESS MODELING AND SIMULATION

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**4-0-0**

Credits:3

Course Objectives:

- To develop mathematical models for chemical engineering processes
- To impart knowledge on modeling of various equipment and their simulation using different numerical techniques.
- To understand various problems associated with numerical solutions and select an appropriate solution technique.
- Understand the computational requirements of various solution options and use this understanding in the selection of the solution method
- Formulate and solve process design problems, based on fundamental analysis and using mathematical models of chemical processes
-

Syllabus:

Unit-1

Mathematical models for chemical engineering systems: classification of mathematical models-steady state vs dynamic models, lumped vs distributed parameter models, deterministic vs stochastic models. Examples of mathematical models- Gravity flow tank, Two heated tanks, batch reactor, constant volume CSTRs, non-isothermal CSTR, CSTRs in series.

Unit-2

Mathematical Modeling: Gas phase pressurized CSTR, Non-isothermal Ideal Plug flow reactor, Plug flow reactor with axial dispersion, Multi component flash drum, ideal binary distillation column, batch distillation with holdup, Heat exchanger, liquid-liquid extractor.

Unit-3

Empirical model building: method of least squares, linear, polynomial and multiple regression, non-Linear regression.

Review of Numerical methods-Solution of Non-linear algebraic equations, system of non-linear linear equations, ordinary differential equations, Partial differential equations.

Unit-4

Process Simulation examples: VLE dew point and bubble point calculations, binary distillation column, gravity flow tank, batch reactor, Non- isothermal CSTR, countercurrent heat exchanger, Non-isothermal Ideal Plug flow reactor, Plug flow reactor with axial dispersion

Unit-5

Process simulation using modular and equation based solving approaches: Developing a simulation model, a simple flow sheet, Sequential modular approach, Simultaneous modular approach, Equation solving approach

Course Outcomes:

- Understand the important physical phenomena from the problem statement
- Develop model equations for the given system
- Demonstrate the model solving ability for various processes/unit operations
- Demonstrate the ability to use a process simulation

Text Books:

1. Process modeling, Simulation and Control for Chemical Engineers, 2nd ed., W. L. Luyben, McGraw-Hill, New York, 1990.
2. Numerical Methods for Engineers, S.K. Gupta, Wiley Eastern, New Delhi, 1995.
3. Chemical Process Modeling and Computer Simulation, Amiya K. Jana, 2012
4. Computational Methods in Process Simulation, Ramirez, W., 2nd Edn., Butterworths, New York,2000.

References:

1. Mathematical Modeling in Chemical Engineering, Franks, R. G. E., John Wiley, 1967
2. Numerical Methods and Modeling for Chemical Engineers, Davis M.E, Wiley New York,1984
3. Introduction to Numerical Methods in Chemical Engineering, P. Ahuja, PHI learning Pvt. Ltd., New Delhi, 2010

CH4102 **TRANSPORT PHENOMENA**

Externals: 60 Marks **L-T-P**

Internals: 40 Marks **4-0-0**

Credits:4

Course Objectives:

- To develop detailed mathematical descriptions of momentum, heat and mass transport.
- To analyze and characterize fluid flow phenomena of various types of fluids under different conditions.
- To develop and solve the equations of change for non-isothermal systems.
- To develop and solve the equations of change for multi-component systems

Syllabus:

Unit-1

Momentum Transport: Viscosity and Mechanism of Momentum Transport-Newton's Law of Viscosity, Shell momentum Balances and boundary conditions, Velocity Distributions in Laminar Flow- Flow of falling film, flow through a circular tube, Flow through Annulus, Flow of two adjacent immiscible fluids, Creeping flow around a sphere.

Unit-2

Equations of change for Isothermal Systems-The equation of Continuity, The equation of motion, The equation of Mechanical energy, Velocity Distributions with more than One independent variable-Time independent flow of Newtonian fluids, Introduction to stream functions Inter-phase transport in isothermal system-Definition of friction factors(FF), flow around tubes, spheres and packed columns.

Unit-3

Energy Transport: -Thermal Conductivity and Mechanism of Energy Transport-Fourier's law of heat conduction, Effect of pressure on thermal conductivity, Temperature Distributions in solids and in Laminar Flow-heat conduction with an electrical heat source, heat conduction with a nuclear heat source, heat conduction with a chemical heat source, heat conduction through composite walls, heat conduction in a cooling fin.

Unit-4

Equations of change for Non-Isothermal Systems-The energy equation, Special Form of the energy equation, Temperature Distributions with more than One Independent Variable-unsteady heat conduction in solids, Steady Potential flow of heat in solids.

Unit-5

Mass Transport: Diffusivity and the mechanism of mass transport-Fick's law of binary Diffusion, Mass and Molar transport by convection, Concentration Distribution in solids-

Diffusion through Stagnant gas film, Diffusion with a heterogeneous chemical reaction, Diffusion with a homogeneous chemical reaction, Diffusion into a falling liquid film.
Laminar Flow-Equation of change for multi component systems.

Course Outcomes

- Understanding of transport processes.
- Ability to do heat, mass and momentum transfer analysis.
- Ability to analyze industrial problems along with appropriate boundary conditions.
- Ability to develop steady and time dependent solutions along with their limitations

Text Books:

1. Transport Phenomena, Bird R.B., Stewart W.E. and Light Foot E.N.– John Wiley International – 2nd Edition , New York, 2002.
2. elements of Transport Phenomena, Sissom L.E, and Pitts D.R, , McGraw Hill, Newyork,1972

Reference Books

1. Fundamentals of momentum, Heat and Mass transfer, Welty J.R, Wicks C.E, Wilson R.E, and Rorer G.L 5th edition, John Wiley & sons Newyork,2007.
2. Transport phenomena for engineers by L. Theodore, International text book company, U.S.A.1971.

CHxxx5 PETROLEUM REFINERY ENGINEERING

(Core Elective-IV)

Externals: 60Marks	**L-T-P**
Internals: 40Marks	**4-0-0**
Credits:3	

Course Objectives:

- Learn the formation, refining of crude oil and products of refinery.
- Understand the means of processing data including thermal properties, important products characteristics.
- Develop skills in drawing neat flow diagrams of different petroleum refining processes
- (cracking/reforming/alkylation/isomerization/hydrocracking etc.,) that are aimed at producing high value/demand products.
- Identify important testing methods for important petroleum products.

Syllabus:

Unit-1

Origin of prtoleum crude oil: thernal properties of petroleum fractions, petroleum evaluation, charecterization of crude oil: TBP and other distillation tests. Petroleum products, their properties, specification and testing , different properties like flash point, fire point, smoke point, aniline point, carbon residue, kinematic viscosity, pour point, freezing point etc.

Unit-2

Fractions of petroleum: dehydration and desalting of crudes, heating of crude-pipe still heaters, distillation of petroleum, blending of gasoline

Treatment techniques: fractions – impurities, gasoline treatment, kerosene treatment, treatment of lubes, wax and purification.

Unit-3

Thermal and catalytic cracking process: Cracking, theory of thermal cracking reactions, properties of cracked materials, depth of cracking and soaking factor, rate of reaction, heat of decomposition, visbreaking.

Unit-4

Thermal and catalytic cracking process: Cracking for the production of gasoline, catalytic cracking, commercial cracking catalysts, catalytic cracking process, fixed bed crackers, moving bed crackers, houdri flow process, flexi cracking.

Unit-5
Hydrotreatment process in refining: hydro-desulfurization, hydrofinishing, production of lube oil base stock

Course Outcomes:

- Understanding the role of petroleum as energy source amidst world energy scenario
- Learning design and operation of petro refineries and petrochemical complexes
- Learning safe practices in operations of refineries and petrochemical complexes
- Identifying challenges, energy security issues and environmental issues
- Techno-economic analysis & trouble shooting
- Building foundation for process intensification
- Motivation towards innovations

Text Books:

1. Petroleum refining Engineering, WL Nelson Mc Graw Hill company, 4th addition:
2. Modern Petroleum Refining Processes, B.K.Bhaskara Rao, Oxford & IBH Publishing, 2002, 4th ed:

CHxxx2 BIOCHEMICAL ENGINEERING

(Core Elective-IV)

Externals: 60 Marks **L-T-P**

Internals: 40 Marks **4-0-0**

Credits:3

Course Objectives:

- Study introduction to the application of chemical engineering principles in biochemical systems.
- Be enabled to understand the biological systems and kinetics of enzymatic reactions.
- Learn the kinetics of growth of micro organisms, hence be able to control the process.
- Be able to design equipments for handing biological processes.
- Study Operations utilized in the purification of biological products enable them to recommend, install and easily learn to operate the equipments.

Syllabus:

UNIT I

Introduction to microbiology: Biophysics and the cell doctrine, the structure of cells, important cell types, from nucleotides to RNA and DNA, amino acids into proteins. Kinetics of enzyme catalyzed reaction: the enzyme substrate complex and enzyme action, simple enzyme kinetics with one and two substrates, other patterns of substrate concentration dependence, modulation and regulation of enzyme activity, other influences on enzyme activity.

UNIT II

Immobilized enzyme technology: enzyme immobilization, industrial processes, utilization and regeneration of cofactors.Immobilized enzyme kinetics: effect of external mass transfer resistance, analysis of intraparticle diffusion and reaction.

Kinetics of cellular growth in batch and continuous culture, models for cellular growth – unstructured, structured and cybernetic models. Thermal death kinetics of cells and spores

UNIT III

Introduction to metabolic pathways, biosynthesis, transport across cell membranes, end products of metabolism, stoichiometry of cell growth and product formation.

Design and analysis of biological reactors: batch reactors, fed-batch reactors, enzyme catalyzed reactions in CSTR, CSTR reactors with recycle and cell growth, ideal plug flow reactors, sterilization reactors, sterilization of gases, packed bed reactors using immobilized catalysts. Fermentation technology: medium formulation, design and operation of a typical aseptic, aerobic fermentation process.

UNIT IV

Transport phenomena in bioprocess systems: Gas-liquid mass transfer in cellular systems, determination of oxygen transfer rates, overall k_La' estimates and power requirements for sparged and agitated vessels, scaling of mass transfer equipment, heat transfer.

UNIT V

Downstream processing: Strategies to recover and purify products; separation of insoluble products-filtration and centrifugation; cell disruption-mechanical and non-mechanical methods; separation of soluble products: liquid-liquid extractions, membrane separation (dialysis, ultra filtration and reverse osmosis), chromatographic separation-gel permeation chromatography, electrophoresis, final steps in purification – crystallization and drying.

Course Outcomes:

- Understanding of biological basics and bioprocessing
- Understanding the difference between bioprocesses and chemical processes
- Bioprocess design and operation
- Choice of bioreactor
- Heat & mass transfer considerations and scale up of bioprocesses
- Introduction to bioprocess monitoring/control

Text Books:

1. Biochemical Engineering Fundamentals, 2nd ed., J.E. Bailey and D.F. Ollis, McGraw-Hill, New York, 1987.

2. Bioprocess Engineering, 2nd ed., M. L. Shuler and F. Kargi, PHI Learning Pvt. Ltd, New Delhi, 2009.

References:

1. Biochemical Engineering, J. M. Lee, Prentice-Hall, New Jersey 1992.

2. Bioprocess Engineering Principles, P. M. Doran, Elsevier, Gurgaon, 2005.

CHxxx2 INSTRUMENTAL METHODS IN CHEMICAL ANALYSIS
(Core Elective-IV)

Externals: 60 Marks **L-T-P**

Internals: 40 Marks **4-0-0**

Credits:3

Course Objectives:

Syllabus:

Unit-1:
UV-Visible Spectrophotometry and Fluorescence Beer-Lambert's law, limitations, Molecular fluorescence, influencing factors, basic instruments, standardization, quantitative methods, applications.

Unit-2:
Atomic spectrometry, atomic absorption, X-ray fluorescence methods Flame atomic emission and absorption, flame emission photometer, flame absorption spectrometer, spectral interferences, quantitative aspects, X-ray fluorescence principle, Instrumentation, quantitative analysis.

Unit-3:
Separation techniques Solvent extraction, Principle, Extraction of solutes, Soxhlet extraction Chromatography methods Gas chromatography, High performance liquid chromatography, Size exclusion chromatography, Principle, Basic instrumentation, Capillary Electrophoresis: Principle and application.

Unit-4:
Thermoanalytical methods Thermogravimetry, Differential thermal analysis, differential scanning calorimetry, Principle, Block diagram, Applications, Quantitative determinations. Electroanalytical methods Coulometric methods, Polarography, Pulse voltammetric methods, Amperometry, Principles, Applications, Electrochemical sensors, Ion selective, Potentiometric and amperometric sensors, Applications.

Unit-5:
Spectroscopic methods Molecular absorption, Woodward rules, applications, Infra red absorption, functional group analysis, qualitative analysis, 1H- and 13C-NMR spectroscopy, Principle, Basic instrumentation, terminology, Interpretation of data, Quantitative applications. Mass spectrometry Principles, Instrumentation, Ionization techniques, Characterization and applications.

Course Outcomes:

- Characterize materials using ultraviolet and visible absorption and fluorescence techniques
- Analyze materials, minerals and trace samples using atomic absorption, emission and X-ray fluorescence techniques
- Analyze environmental, industrial, production-line materials by liquid, gas and size-exclusion chromatographic techniques.
- Characterize interfaces and traces of surface adsorbed materials using electro-analytical techniques
- Understand principles of thermogravimetry and differential thermal analyses.
- Characterize chemical, inorganic and engineering materials using analytical techniques

Text Books:

1. Mendham, Denny, Barnesand Thomas, Vogel: Text book of Quantitative Chemical Analysis, Pearson Education, 6th Edition, 2007.
2. Skoog, Holler and Kouch, Thomson, Instrumental methods of chemical analysis, 2007.
3. Willard, Meritt and Dean, Instrumental methods of chemical analysis, PHI, 2005.

CHxxx7 COMPUTATIONAL FLUID DYNAMICS

(Open Elective-II)

Externals: 60 Marks **L-T-P**

Internals: 40 Marks **4-0-0**

Credits:3

Course Objective:

- To be able to apply to apply the conservation laws to fluids in motion under different conditions
- To learn modeling of fluid flow under different conditions
- To learn how to convert differential equations to difference equations and to learn grid generation methods
- To simulate the model

Syllabus:

Unit-1 Conservation Laws And Turbulence Models

Governing equations of fluid flow and heat transfer –mass conservation, momentum and energy equation, differential and integral forms, conservation and non-conservation form. Characteristics of turbulent flows, time averaged Navier Strokes equations, turbulence models-one and two equation, Reynolds stress, LES and DNS

Unit-2 Finite Differnce Approximation

Mathematical behaviour of PDE, finite difference operators, basic aspects of discretization by FDM, explicit and implicit methods, error and stability analysis

Unit-3 Finite Volume Method

Diffusion problems – explicit and implicit time integration; Convection-diffusion problems – properties of discretisation schemes, central, upwind, hybrid, QUICK schemes; Solution of discretised equations.

Unit-4 Flow Field Computation

Pressure velocity coupling, staggered grid, SIMPLE algorithm, PISO algorithm for steady and unsteady flows

Unit-5 Grid Generation

Physical aspects, simple and multiple connected regions, grid generation by PDE solution, grid generation by algebraic mapping.

Course Outcomes:

- At the end of the course, the students will be able to:
- Understand the basic principles of mathematics and numerical concepts of fluid dynamics.

- Develop governing equations for a given fluid flow system.
- Adapt finite difference techniques for fluid flow models.
- Apply finite difference method for heat transfer problems.
- Solve computational fluid flow problems using finite volume techniques.
- Get familiarized tomodern CFD software used for the analysis of complex fluid-flow systems.

Text Books:

1. Computational Fluid Dynamics: The Basics with Applications, Anderson, J. D., McGraw-Hill, 1995.
2. Computational Techniques for Fluid Dynamics, Fletcher, C. A. J., Springer Verlag, 1997.

References:

1. An Introduction to Computational Fluid Dynamics:The Finite Volume Method, Versteeg, H.K. and Malalasekera, W.,Pearson Education Ltd., 2007.
2. Computational Fluid Dynamics, Chung T.J , Cambridge University Press 2003.
3. Computational Fluid Flow and Heat Transfer, Muralidhar, K., and Sundararajan, T., Narosa Publishing House, New Delhi, 2001.
4. Numerical heat transfer fluid flow, Subas, V. Patankar Hemisphere Publishing Corporation, 1980.

CHxxx7 **GREEN TECHNOLOGY**

(Open Elective-II)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **4-0-0**
Credits:3

Course Objectives:

Syllabus:

Unit-1:
Principles and concepts of Green Chemistry: Introduction, Sustainable Development and Green Chemistry, Atom Economy, Atom Economic Reactions, Rearrangement Reactions, Addition Reactions, Atom Un-economic Reactions, Substitution Reactions, Elimination Reactions, Wittig Reactions, Reducing Toxicity, Measuring Toxicity.

Unit-2:
Waste- Production, Problems and Prevention: Introduction, Some Problems Caused by Waste, Sources of Waste from the Chemical Industry, The Cost of Waste, Waste Minimization Techniques, The Team Approach to Waste Minimization, Process Design for Waste Minimization, Minimizing Waste from Existing Processes, On-site Waste Treatment, Physical Treatment, Chemical Treatment, Biotreatment Plants, Design for Degradation, Degradation and Surfactants, DDT, Polymers, Some Rules for Degradation, Polymer Recycling, Separation and Sorting, Incineration, Mechanical Recycling, Chemical Recycling to Monomers.

Unit-3:
Measuring and controlling environmental performance: The Importance of Measurement, Lactic Acid Production, Safer Gasoline, Introduction to Life Cycle Assessment, Green Process Metrics, Environmental Management Systems, The European Eco-management and Audit Scheme, Eco-labels, Legislation, Integrated Pollution Prevention and Control.

Unit-4:
Catalysis and green chemistry: Introduction to Catalysis, Comparison of Catalyst Types, Heterogeneous Catalysts, Basics of Heterogeneous Catalysis, Zeolites and the Bulk Chemical Industry, Heterogeneous Catalysis in the Fine Chemical and Pharmaceutical Industries, Catalytic Converters, Homogeneous Catalysis, Transition Metal Catalysts with Phosphine Ligands, Greener Lewis Acids, Asymmetric Catalysis, Phase Transfer Catalysis, Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide, Biocatalysis, Photocatalysis.
Organic solvents, Environmentally benign solutions: Organic Solvents and Volatile Organic Compounds, Solvent-free Systems, Supercritical Fluids, Supercritical Carbon Dioxide, Supercritical Water, Water as a Reaction Solvent, Water-based Coatings, Ionic Liquids, Ionic Liquids as Catalysts, Ionic Liquids as Solvents, Fluorous Biphase Solvents.

Unit-5:
Renewable resources: Biomass as a Renewable Resource, Energy, Fossil Fuels, Energy from Biomass, Solar Power, Other Forms of Renewable Energy, Fuel Cells, Chemicals from Renewable Feedstocks, Chemicals from Fatty Acids, Polymers from Renewable Resources, Some Other Chemicals from Natural Resources, Alternative Economies, The Syngas Economy, The Biorefinery, Chemicals from renewable feed stocks.

Course Outcomes:
- Understand principles and concepts of green chemistry
- Develop manufacturing processes to reduce wastage and energy consumption.
- Design the technologies to reduce the level of emissions from buildings and core infrastructure
- Analyze the effects of pollutants on the environment

Text books:
1. Mike Lancaster, Green Chemistry, Royal Society of Chemistry, 2010.

2. Paul T. Anastas John C. Warner, Green Chemistry: Theory and Practice, Oxford University Press, 2000.

3. Jay Warmke, Annie Warmke, Green Technology, Educational Technologies Group, 2009.

CHxxx7 **WATER AND WASTE WATER TREATMENT**

(Open Elective-II)

Externals: 60 Marks **L-T-P**

Internals: 40 Marks **4-0-0**

Credits:3

Course Objective:

Syllabus

Unit-1:

Water quality and Characteristics: Safe Drinking Water Act, Microbiological quality of drinking water, chemical quality of drinking water, clean water act, National Pollutant Discharge Elimination System (NPDES), Pollution effect on aquatic life, Ground water quality, Seawater quality, Domestic wastewater, Industrial wastewaters, Infiltration and inflow, Municipal waste water, Composite sampling, Evaluation of Wastewater.

Unit-2:

Water Processing: Surface-water treatment, Mixing and Flocculation, Sedimentation, Direct Filtration, Ballasted Flocculation, Flocculator-Clarifiers, Filtration, Chemical Coagulation, Taste and Odor Control, Synthetic Organic Chemicals, Fluoridation, Chlorination, Disinfection By-products, Ozone Disinfection of Potable Water, Groundwater Treatment, Precipitation Softening, Iron and Manganese Removal, Water Stabilization, Groundwater Chlorination, Ion Exchange, Anion

Exchange for Nitrate Removal, Arsenic Removal, Defluoridation, Membrane Filtration, Microfiltration and Ultra filtration, Reverse

Osmosis, Distillation of Seawater, Sources of Residuals in Water Treatment, Selection of Processes for Water Treatment Residuals, Description of Pressure Filtration, Disposal of Dewatered Sludge.

Unit-3:

Physical Unit Operations: Screening, Coarse Solids Reduction, Flow Equalization, Mixing and Flocculation, Primary Sedimentation, Flotation, Oxygen Transfer, Aeration Systems, Removal of Volatile Organic Compounds.

Unit-4:

Chemical Unit Processes: Role of Chemical Unit Processes in Wastewater Treatment, Fundamentals of Chemical Coagulation, Chemical Precipitation for Improved Plant Performance, Chemical Precipitation for Phosphorus Removal, Chemical Precipitation for Removal of Heavy Metals and Dissolved, Chemical Oxidation, Chemical Neutralization, Scale Control, and Stabilization, Chemical Storage, Feeding, Piping and Control Systems.

Unit-5:
Fundamentals of Biological Treatment: Overview of Biological Wastewater Treatment, Composition and Classification of Microorganisms, Introduction to Microbial Metabolism, Bacterial Growth and Energetic, Microbial Growth Kinetics, Modeling Suspended Growth Treatment Processes, Substrate Removal in Attached Growth Treatment Processes, Aerobic Biological Oxidation, Biological Phosphorus Removal, Anaerobic Fermentation and Oxidation, Biological Removal of Toxic and Recalcitrant Organic Compounds, Biological Removal of Heavy Metals.

Course Outcomes:
- Analyze water quality and discuss its standards. Discuss sources of pollutant water and its effect on environment.
- Classify various treatment methods during processing of water.
- Use different unit operations equipment in waste water treatment.
- Explain and compare various chemical processes for Waste Water Treatment.
- Explain and compare various biological treatment methods.

Text books:
1. Mark J. Hammer, Mark J. Hammer, Jr., *"Water and Wastewater Technology"*, 7th Edition, PHI Learning Private Ltd., New Delhi, 2012.

Reference:
1. Metcalf & Eddy, *"Wastewater Engineering Treatment and Reuse"* 4th Edition, Tata McGraw Hill Education Private Ltd. New Delhi,1992.

CHxxx7 **FLUIDIZATION ENGINEEING**
(Open Elective-III)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **4-0-0**
Credits:3

Course Objectives:

Syllabus
Unit-1:
Introduction: The phenomenon of fluidization; liquid like behaviour of a fluidized bed; Comparison with other contacting methods; Advantages and disadvantages of fluidized beds.

Unit-2:
Industrial applications of fluidized beds: Coal gasification; gasoline from other petroleum fractions; Gasoline from natural and synthesis gases; Heat exchange; Coating of metal objects with plastics; Drying of solids; Synthesis of phthalic anhydride; Acrylonitrile; Polymerization of olefins; FCCU; Fluidized combustion of coal; incineration of solid waste; Activation of carbon; gasification of waste; bio-fluidization.

Unit-3:
Fluidization and mapping of regimes: Minimum fluidization velocity; Pressure drop vs. velocity diagram; effect of temperature and pressure on fluidization; Geldart classification of particles; terminal velocity of particles; turbulent fluidization; pneumatic transport of solids; fast fluidization; solid circulation systems; Voidage diagram; Mapping of regimes of fluidization.

Unit-4:
Bubbles in dense bed: Single rising bubbles; Davidson model for gas flow at bubbles; Evaluation of models for gas flow at bubbles. Bubbling Fluidized beds: Experimental findings; Estimation of bed porosities; Physical models: simple two phase model; K-L model. High velocity Fluidization: Turbulent fluidized bed; Fast fluidization pressure drop in turbulent and fast fluidization.

Unit-5:
Solids Movement, Mixing, Segregation and staging: Vertical movement of solids; Horizontal movement of solids; Staging of fluidized beds. Gas Dispersion and Gas interchange in Bubbling Beds: Dispersion of gas in beds; Gas interchange between bubble and emulsion; Estimation of gas interchange coefficients. Particle to Gas Mass Transfer: Experimental interpolation of mass transfer coefficients; Heat transfer; Experimental heat transfer from the bubbling bed model.

Course Outcomes:

- Explain the basics of fluidization.
- Describe the various industrial applications of fluidization. CO3: Explain the various fluidization regimes, classification of particles.
- Describe the K-L bubbling model.
- Describe the staging of fluidized beds, and calculation of the exchange coefficient

Text books:

Fluidization Engineering, 2nd ed., D. Kunii and O. Levenspiel, Butterworth-Heinemann, London,1999.

CHxxx7 **CORROSION ENGINEERING**
(Open Elective-III)

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**4-0-0**

Credits:3

Course Objectives:

1. Definition and classification of corrosion.
2. Principles of corrosion, common corrosion forms,
3. Different corrosion testing methods.
4. Corrosion control methods and material selection for cost reduction. 5. Modern theories to explain corrosion

Syllabus:

Unit-1:

Introduction: Definition, corrosion environments, damage, classification of corrosion. Principles and corrosion rate expressions. Environmental effects such as velocity, temperature, galvanic coupling. Metallurgical and other aspects

Unit-2:

Different forms of corrosion: Uniform attack, galvanic corrosion, crevice corrosion, fitting corrosion, inter– granular corrosion, selective leaching, erosion corrosion, stress corrosion and hydrogen damage. Pitting: pit shape and growth, velocity, metallurgical variables, evaluation of pitting damage, prevention.

Unit-3:

Corrosion testing methods: Classification, purpose, surface preparation, measuring and weighing, duration, plant interval test, NACE test methods, slow – strain rate test and paint test. Composites testing: Exposure techniques, Huey test, Sea water test, Stress corrosion, Corrosion of palstics, Invivo corrosion.

Unit-4:

Corrosion prevention methods: Selection of metals and alloys–Cast iron, steel, Al, Mg, Ti, Composites and Refractory metals. Non-metallics: Thermosetters, laminates and reinforced plastics, Rubbers, Wood, Ceramics, Carbon and Graphite. Alteration of environment such as changing mediums, lowering temperature, design rules, design of cathodic and anodic protection, selected coating techniques to prevent corrosion; Failure analysis. High temperature corrosion.

Unit-5:

Advanced techniques: Modern theory–principles and applications, electrode kinetics, predicting corrosion behavior, corrosion prevention, Corrosion rate measurements in Petroleum Industry with examples.

Course Outcomes:

1. Identity the type of corrosion.
2. Correlate the damage with the cause of corrosion.
3. Identify the correct method of testing any corrosion.
4. Select the appropriate preventive method to avoid corrosion.
5. Select the significant coating for corrosion prevention.
6. Apply modern method of corrosion measurement.

Text Books:

1. Pierre R. Roberge, " Handbook of Corrosion Engineering", 2nd edition, MCGraw-Hill, Newyork, 2012

2. Zaki Ahmad, "Principles of Corrosion Engineering and Corrosion Control", Butterworth-Heinemann, 2006.

Reference Textbooks:

1. Pierre R Roberge, "Corrosion Engineering – Principles and Practice, MCGraw-Hill, 2008

2. Pierre R. Roberge, Corrosion Basics: An Introduction, NACE International, 2006.

CHxxx7 MINERAL PROCESSING TECHNOLOGY

(Open Elective-III)

Externals: 60 Marks L-T-P
Internals: 40 Marks 4-0-0
Credits:3

Course objectives:

1. Review all unit operations in mineral processing technology and the mineral concentration processes.
2. Introduce students to the importance and principles of materials handling in the mineral processing plant with special emphasis on feeding and conveying of bulk material.
3. Provide students the opportunities to acquire practical skills in concentrates handling, grade.
4. Determination, recovery and loss calculation and participatory laboratory experiments.

Syllabus:

Unit-1:

Introduction to Mineral Processing, Scope and importance. Properties and Types of Minerals Ore handling: removal of harmful materials - sampling of ores: moisture sampling, assay sampling, sampling systems, sample division methods.

Unit-2:

Mineral Liberation, degree of liberation, concentration, measures of assessing metallurgical performance viz., recovery, ration of concentration, grade, enrichment ratio.
Laboratory sizing: particle size and shape, sieve analysis, sub sieve techniques, centrifugal methods (warman cyclosizer), microscopic sizing, online particle size analysis.

Unit-3:

Classification: Principle, types of classifiers – Gravity concentration: principle, concentration in vertical surren (Jigging), Jigs, types of Jigs viz., Harz Jig, circular and radial jigs, coal jigs (Baum and Batac jigs) – Gravity concentration in streaming currents: pinched sluice, cones, spirals, shaking tables.

Unit-4:

Heavy medial separation: Principle, liquids and suspension for heavy media separation.
Separation vessels : Gravitational vessels (Wemco Cone separator, Drum separator) Centrifugal separators: (Vorsyl separator, LARCODEMS, Dyna whirlpool separator) DMS cyclone DMS circuits.

Unit-5:
Floatation – History and theory: contact angle, work of adhesion; Floatation Reagents: collectors, frothers, regulators; and their action – Floatation practice: ore and pulp preparation, reagents and conditioning- Flotation Machines: pneumatic (Davcra cell, flotation column, Jameson cell, froth separators) and mechanical (Denver cell, Wemco cell) electro flotation, skin flotation, Case studies: i) Coal Beneficiation process. ii) Different methods for fine particles collections(Copper, Iron, Au).

Course Outcomes:
1. Understand the principles governing a range of processes applied in the mineral industry.
2. Describe typical unit processes and flow-sheets for production of a number of metals.
3. Apply basic engineering principles to the design of mineral processes.
4. Produce conceptual designs for simple extraction processes.
5. Understand the operation of beneficiation units for coal and mineral.

Text Books:
1. B.A.Wills – "Mineral Processing Technology " –7th edition Maxwell International Edition - 1987.
2. S.K.Jain "Ore Processing"Oxford and TBHY Publishing Co. (P) Ltd., India (1986). 3. S. K. Jain, Ore Processing, Oxford- IBH Publishing Company, 2005.

Reference Text books:
1. Ashoka Gupta & Denis Yen, "Mineral Processing Design and Operations", 1st Edition, Elsevier Publishers.

CH4103 **DESIGN AND SIMULATION LAB**

Externals: 60 Marks **L-T-P**

Internals: 40 Marks **0-0-3**

Credits:1.5

Course Objectives: To introduce students to use of software packages such as ASPEN, FLUENT for simulation, and also analysing flowsheets

The following are the contents:

1.Introduction to Software Packages
2. Setting up models for simulation
3. Steady State simulation using ASPEN, Flowsheeting concepts (sequential modular, equation oriented)
4. Dynamic simulation
5. CFD simulations using FLUENT, geometry & meshing

Course Outcomes: Students will be able to

- Solve chemical engineering problems using advanced programming softwares
- Use simulation softwares like ASPEN and FLUENT
- Analyze the techno-economic feasibility of chemical manufacturing facility

Text Books: As per manuals/literature supplied by Software Vendor

CH4104 PROCESS MODELLING AND SIMULATION LABORATORY

Externals: 60 Marks	**L-T-P**
Internals: 40 Marks	**0-0-3**
Credits: 1.5	

Course Objectives:

To make the student familiar with software and simulation of chemical processes equipments.

The following experiments have to be conducted using C/C++/MATLAB

1. Introduction to MATLAB: Loops, Branches and Control Flows
2. Solving a linear system using Gaussian elimination method
3. Finding Eigen vectors, eigen values for a linear system, Curve fitting tool box
4. Solving an ordinary differential equation, PDE etc
5. Three CSTR's in series – open loop & closed loop
6. Non isothermal CSTR
7. Isothermal batch reactor – open loop
8. Non-isothermal Batch reactor
9. Plug flow reactor
10. Heat Exchanger
11. Gravity Flow tank.
12. Bubble point & Dew point calculations
13. Binary Distillation column

Course Outcomes:

- Identify MATLAB as a simulating tool to solve chemical engineering problems
- Solve steady state chemical engineering problems using MATLAB
- Develop solutions for different ideal reactor systems
- Simulate basic Heat transfer and Mass transfer equipment

FOURTH YEAR (E4) SEMESTER-II

S.NO.	Code	Course title	Category	Hours per week			Credits
				Lecture	Tutorial	Practical	
1	CHxxx	Core Elective -V	PCE	3	0	0	3
2	CHxxx	Open Elective- IV	OCE	3	0	0	3
3	CH4201	Major Project	SIP	0	0	0	8
4	CH4202	Comprehensive Viva-II	SIP	0	0	0	1
						TOTAL	15

Core Elective-V:

1. Process Optimization
2. Technology of Pharmaceuticals and fine Chemicals
3. Pulp and Paper Technology

Open Elective-IV:

1. Energy Engineering
2. Statistical Thermodynamics
3. Finite Difference Methods in Transport Processes

CHxxx1 **PROCESS OPTIMIZATION**

(Core Elective-V)

Externals: 60 Marks **L-T-P**

Internals: 40 Marks **4-0-0**

Credits:3

Course Objectives:

- To learn problem formulation of optimization.
- To realize the numerical methods of un-constrained optimization.
- To learn linear programming and its applications
- To understand the use of genetic algorithms in optimization
- To know the applications of numerical optimization.

Syllabus:

Unit-1

Nature and organization of optimization problems- introduction to optimization scope and hierarchy of optimization, examples of applications of optimization, essential features of optimization problems, general procedure for solving optimization problems, Optimization of a manufacturing problem with a stepwise procedure, obstacles of optimization, constraints in optimization, examples and formulation of constrained optimization problems.

Basic concepts of optimization: Continuity of functions, unimodal versus Multimodel functions. Convex and Concave functions, Convex region, Necessary and sufficient conditions for an extremum of an unconstrained function.

Unit-2

Optimization of unconstrained single variable functions: Region elimination methods: Fibonacci search, Golden section search. Polynomial approximation methods- Sequential search,. Methods specifying optimum by a point: Newton's method, Secant method, Quadratic interpolation, Cubic interpolation. Applications of one- dimensional search methods to chemical engineering problems.

Unit-3

Unconstrained multivariable optimization: Random search methods, grid search, uni-variate search, multivariable Newton's method, Steepest descent method, Conjugate search directions, Conjugate gradient method, Powell's method.

Constrained multi variable optimization- direct substitution, penalty function approach, slack variables, method of Lagrangian multipliers, Kuhn- Tucker conditions.

Unit-4

Optimization of Unit operations: Optimal pipe diameter, minimum work of compression, Economic operation of a fixed bed filter, optimizing recovery of waste heat, optimization of multiple effect evaporator, optimization of flow rates in Liquid- Liquid extraction column, Determination of optimal reflux ratio for staged distillation column.

Unit-5

Linear programming and applications: Basic concepts in linear programming, graphical solution, artificial variable technique, exceptional cases in LPP, non-existing feasible solution, degeneracy, duality in linear programming, dual simplex method, revised simplex method, linear programming applications including optimization of a thermal cracker.

Course Outcomes:

- Identify different types of optimization problems
- Understanding of different optimization technique
- Ability to solve various multivariable optimization problems
- Ability to solve optimization using software tools.
- Identify different types of test of Hypotheses.
- Ability to solve problems by using least square analysis.
- Understand Correlation and Regression

Text Books:

1. Optimization of Chemical Processes, T.F. Edgar and D.M. Himmelblau, McGraw-Hill, New York, 2001.
2. Optimization for Engineering Design, Kalyan Moy Deb, PHI Pvt. Ltd., New Delhi, 2000

CHxxx6 Technology of Pharmaceuticals and Fine Chemicals
(Core Elective-V)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **4-0-0**
Credits: 3

Course Objectives:

- To understand the grades of chemicals and impurities in chemicals.
- Outlines of Preparation, properties, uses and testing of the following Pharmaceuticals like sulfacetamide, paracetamol, riboflavin, nicotinamide
- To study the properties and preparation methods pharmaceuticals like aspirin, penicillin and calcium gluconate.
- To study the manufacturing process and analyzing process flow sheets.
- To know the tablet making and coating, preparation of capsules.

Syllabus:

Unit-1
A brief outline of grades of chemicals, sources of impurities in chemicals, principles (without going into details of individual chemicals) of limit test for arsenic, lead, iron, chloride and sulfate in Pharmaceuticals.

Unit-2
Outlines of Preparation, properties, uses and testing of the following Pharmaceuticals - sulfacetamide, paracetamol, riboflavin, nicotinamide,
Outlines of Preparation, properties, uses and testing of the following fine chemicals - Methyl orange, fluorescence, procaine hydrochloride, paramino salicylic acid, isonicatinic acid hydrazide.

Unit-3
Manufacture with flowsheets, properties uses and testing of the following Pharmaceuticals – aspirin, penicillin, calcium gluconate.

Unit-4
Manufacture with flowsheets, properties uses and testing of the following ferric ammonium citrate, pthallic anhydride and phenol flourobenzene process and benzene sulfate process, other processes in outline only.

Unit-5
Tablet making and coating, granulation equipments
Preparation of capsules, extraction of crude drugs.

Sterilization: introduction, risk factor, methods of sterilization, heat (dry and moist), heating with bactericide, filtration, gaseous sterilization and radiation sterilization, suitable example to be discussed.

Course outcomes:

At the end of the course, the students will be able to:

- Learn the principles of limit test for pharmaceuticals and sources of impurities in chemicals.
- Preparation outlines for the manufacture of pharmaceuticals and fine chemicals.
- Design various unit operations pertinent to fine chemicals and pharmaceuticals sectors
- Investigate environmental impacts in the field of pharmaceuticals and fine chemicals

Text Books:

1. Remington's Pharmaceutical Science,16th ed, Mac publishing company, 1980.
2. Industrial Chemicals, 3rd ed., Faith, Kayes and Clark, John Wiley & Sons,. 1965.

References:

1. Blently's Text Book of Pharmaceutical Chemistry, 8th ed, H A Rawlins, B Tindell and Box,. Oxford University Press, London, 1977.

CHxxx6 **PULP AND PAPER TECHNOLOGY**

(Core Elective-V)

Externals: 60 Marks **L-T-P**
Internals: 40 Marks **4-0-0**
Credits: 3

Course Objectives:

Syllabus:

Unit-1:

Introduction: History of Paper Making, Technological Advancements, Global and Indian Market Situation.

Unit-2:

Paper making raw materials: Wood anatomy and chemistry, Wood chip preparation and handling at the pulp mill, Solid wood measurement, Properties of selected wood species.
Pulping processes: Introduction to pulping, Mechanical pulping, Chemical pulping, Semi-chemical pulping, Soda pulping, Kraft pulping, Sulfite pulping, Other pulping methods.

Unit-3:

Pulp treatment: Bleaching mechanical pulps, Measurement of lignin content, Bleaching chemical pulps, Chemical recovery, Refining, Pulp characterization.

Unit-4:

Paper making equipment and process: Fiber preparation and approach, Raw materials, Functional additives, Control additives, Wet end chemistry, Paper manufacture, Paper machine, headbox, fourdrinier wet end, Twin wire formers, cylinder machine, press section, dryer section, Post drying operations, Coating.

Unit-5:

Environmental protection: Water pollution, Water quality tests, Aqueous effluent treatments, Air pollution, Air quality tests and control, Solid waste disposal.
Properties of paper: General grades of paper, Structure, Mechanical and chemical properties, Basic optical tests of paper.

Course Outcomes:

- Explain process for manufacturing paper.
- Understand harmful impacts of paper and pulp industries on environment.
- Understand mechanical pulping, Chemi-thermo-mechanical processes, chemical pulping.
- Understand methods for pulp treatment.

Text books:

1. J.P. Casey, Pulp and Paper: Chemistry and Chemical Technology, 3rd Edition, Volumes 1 & 2., Wiley Interscience, 1980
2. G.A. Smook, Handbook for Pulp and Paper Technologists, 3rd Edition, Angus Wilde Publ, Inc, 2002.
3. Christopher J. Biermann, Handbook of Pulping and Paper Making, Academic Press, 1996.

CH3103 **ENERGY ENGINEERING**
(Open elective-IV)

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **4-0-0-4**

Course Objectives:

- To acquaint the student with the conventional energy sources and their utilization.
- Importance of heat recovery and energy conservation methods and energy audit

Syllabus:

Unit-1
Sources of energy, types of fuels- energy and relative forms. Calorific value- gross and net value, calculation of calorific value from fuel analysis, experimental determination energy resources present and future energy demands with reference to India.
Coal: origin, occurrence, reserves, petrography, classification, ranking, analysis, testing, storage, coal carbonization and byproduct recovery, liquefaction of coal, gasification of coal, burning of coal and firing mechanism, burning of pulverized coal.

Unit-2
Liquid fuels: petroleum: origin, occurrence, reserves, composition, classification, characteristics, fractionation, reforming, cracking, petroleum products, specification of petroleum products, burning of liquid fuels.
Natural gas, coke oven gas, producer gas, water gas, LPG, burning of gaseous fuels, hydrogen (from water) as future fuel, fuel cells, flue gas, analysis: orsat apparatus

Unit-3
Steam Plant: Run time cycle, boiler plant, steam cost, steam distribution and utilization, combined heat and power systems, energy from biomass and biogas plants, gas purification, solar energy, wind energy, energy storage

Unit-4
Waste heat recovery, sources of waste heat and potential application, various types of heat recovery systems, regenerators, recuperators, waste heat boilers
Energy conservation: conservation methods in process industries, theoretical analysis, practical limitations.

Unit-5
Energy auditing: short term, medium term, long term schemes, energy conversion, energy index, energy cost, representation of energy consumption, Sankey diagram, energy auditing.

Course Outcomes:

- Knowledge of solid, liquid and gaseous fuels
- Knowledge of characterization techniques for fuels
- Knowledge of alternate energy sources

- To know the energy demand of world, nation and available resources to fulfill the demand.

Text Books:

1. Fuels, Furnaces and Refractories, O.P.Gupta
2. Fuels and Combustion, 3rd ed., Samir Sarkar, Universities Press, 2009.

Reference Books:

1. Non-conventional Energy Resources, G.D.Rai, Khanna Publishers
2. Fuel and Energy, Harker and Backhurst, Academic press London 1981
3. Fuel Science- Harker and Allen, Oliver and Boyd, 1972

CH3103 **STATISTICAL THERMODYNAMICS**
(Open elective-IV)

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **4-0-0-4**

Course Objectives:

Syllabus:

Unit-1:
Basics of Statistical Thermodynamics: The Statistical Foundation of Classical Thermodynamics, Classification Scheme for Statistical Thermodynamics, Importance of Statistical Thermodynamics.

Unit-2:
Ensembles: Ensembles and Postulates, Canonical Ensemble, Canonical Ensemble and Thermodynamics, Grand Canonical Ensemble, Micro Canonical Ensemble, Thermodynamic Equivalence of Ensembles.

Unit-3:
Evaluation of Probabilities: Probability- Definitions and Basic Concepts, Permutations and Combinations, Distribution Functions: Discrete and Continuous, Binomial Distribution, Poisson distribution, Gaussian Distribution, Combinatorial Analysis for Statistical Thermodynamics. Criteria for Equilibrium: Equilibrium Principles, States of Equilibrium: Neutral, Metastable, and Unstable equilibrium, Maximizing Multiplicity.

Unit-4:
Model for Mono-atomic Ideal Gas and Polyatomic Ideal Gases: Energy Levels and Canonical Ensemble, Partition Function, Thermodynamic Functions for Mono-atomic Ideal Gases, Grand Ensemble, Internal Degrees of Freedom, Independence of Degrees of Freedom, Potential Energy Surface, Vibration, Rotation, Thermodynamic Functions for Poly-atomic Ideal Gases, Hindered Internal Rotation in Ethane, Hindered Translation on a Surface.

Unit-5:
Einstein's and Debye's Model of the Solid, Simple Liquids, Phase Equilibrium, Models for Multi-Component Systems: Ideal Lattice Gas, Lattice Gas with Interactions, Solutions (Bragg-William Model and Regular Solutions, Quasi-Chemical Model), Chemical Equilibrium.

Course Outcomes:
- Identify the molecular level properties influencing the macroscopic properties.
- Develop models for simulating real gases, liquids and solids using ensemble methods to estimate thermodynamic properties
- Design molecular level architecture to enhance macroscopic properties.

- Estimate macroscopic properties based on molecular level interactions.

Text books:

1. Leonard K. Nash, Elements of Statistical Thermodynamics, 2nd Edition, Dover Publications, 2006.

2. Normand M. Laurendeau, Statistical Thermodynamics: Fundamentals and Applications, Cambridge University Press, 2005.

3. Stanley I. Sandler, An Introduction to Applied Statistical Thermodynamics, John Wiley &Sons, 2010.

CH3103 FINITE DIFFERENCE METHODS IN TRANSORT PROCESSES

(Open elective-IV)

Externals: 60 Marks **L-T-P-C**

Internals: 40 Marks **4-0-0-4**

Course Objective:

Syllabus:

Unit-1:

Basic Relations: Classification of Second – order Partial differential Equations, Parabolic systems, Elliptic systems, Hyperbolic systems, Systems of equations, Boundary conditions, Uniqueness of the solution.

Discrete Approximation of Derivatives:

Taylor Series formulation, Finite difference operators, Control- Volume Approach, Application of control –Volume Approach, Errors involved in numerical solution.

Unit-2:

One- Dimensional Parabolic systems:

Simple Explicit Method, Simple Implicit Method, Crank- Nicolson Method, Combined Method, Three- Time-Level Method, Cylindrical and Spherical Symmetry, A summary of Finite – Difference Schemes.

Multidimensional Parabolic Systems:

Simple Explicit Method (i) Two Dimensional diffusion (ii) Two-dimensional steady laminar boundary layer flow (iii) One- Dimensional Transient convection- diffusion (iv) Two-Dimensional transient convection- diffusion, Combined Method (i) Three-dimensional diffusion (ii) One-dimensional transient convection and diffusion,

Alternating Direction Implicit (ADI) method, Alternating Direction Explicit (ADE) Method (i) One Dimensional diffusion (ii) Two dimensional diffusion, Modified Upwind Method :

Transient Forced convection inside ducts for step change in fluid inlet temperature, Upwind method for free convection over a vertical plate.

Unit-3:

Elliptic systems: Steady –State diffusion, Velocity field for incompressible, Constant property, Two dimensional Flow, Temperature field in incompressible, constant property Two – dimensional Flow.

Hyperbolic System: Hyperbolic convection (Wave) equation, Hyperbolic Heat conduction equation, System of Vector equations.

Unit-4:

Phase Change Problems: Mathematical formulation of phase change problems, Variable Time step approach for single–phase solidification, Variable Time step approach for two – phase solidification, Enthalpy Methods.

Unit-5:

Numerical Grid Generation: Coordinate Transformation relation, Basic ideas in simple transformations, Basic ideas in numerical grid generation and mapping, Boundary value problem of numerical grid generation, Finite difference representation of Boundary value problem of numerical grid generation, Steady state Heat conduction in irregular geometry, Laminar free – convection in irregular enclosures.

Course Outcomes:

- Classify partial differential equations and also able to apply FDM to solve Partial differential equations.
- Discretize the partial differential equations for steady and unsteady state multidimensional diffusion and convective equations.
- Analyze the velocity and temperature field in any system
- Formulate and solve the phase change problems
- Create and transform the irregular shaped to regular geometry

Text books:

1. Ozisik M.N, *"Finite Difference Method in Heat Transfer",* CRC Press, 1994.

Reference Text books:

1. Anderson D.A, Tannehill JC, Pletcher RH, *"Computational Fluid Mechanics and Heat Transfer"*McGrawHill, 1984.

Credits required for Open elective as per AICTE- 18*

S.NO.	Code	Open Elective	Semester	Credits
1	CHxxx	Open Elective-I	6	3
2	CHxxx	Open Elective-II	7	3
3	CHxxx	Open Elective-III	7	3
4	CHxxx	Open Elective-IV	8	3
			TOTAL	12

Credits required for Core elective as per AICTE- 18*

S.NO.	Code	Core Elective	Semester	Credits
1	CH3104	Core Elective-I	5	3
2	CH3105	Core Elective-II	5	3
3	CH3203	Core Elective-III	6	3
4	CHxxx	Core Elective-IV	7	3
5	CHxxx	Core Elective- V	8	3
			TOTAL	15

Credits required for Basic Science courses as per AICTE- 25*

S.NO.	Code	Course Title	Year-Semester	Credits
1	CH-MA1101	Mathematics-I	E1-S1	4
2	CH-PH1101	Physics	E1-S1	4
3	CH-CY1101	Chemistry -I	E1-S1	4
4	BSBE1101	Biology	E1-S1	3
5	CH-PH1102	Physics lab	E1-S1	1.5
6	CH-CY1102	Chemistry lab	E1-S1	1.5
7	CH-MA1201	Mathematics-II	E1-S2	4
8	CH-CY1201	Chemistry-II	E1-S2	4
9	CH-MA2101	Mathematics-III	E2-S1	4
				30

Credits required for Engg. Science courses as per AICTE- 24*

S.NO.	Code	Course Title	Year-Semester	Credits
1	CH1201	Engg. Thermodynamics-I	E1-S2	4
2	CH-ME1201	Engineering and Solid Mechanics	E1-S2	3
3	CS1201	Programming for problem solving	E1-S2	3
4	CE1201	Engineering Graphics	E1-S2	2
5	ME1201	Engineering Workshop	E1-S2	1.5
6	CS1202	Programming for problem solving lab	E1-S2	1.5
7	CH-EE2101	Basic Electrical& Electronics Engineering.	E2-S1	3
8	CH-EE2102	Basic Electrical& Electronics Engineering Lab.	E2-S1	1.5
9	CH-MM2201	Material Science	E2-S2	3
			Total	22.5

Credits required for Humanities courses as per AICTE- 12*

S.NO.	Code	Course Title	Year-Semester	Credits
1	HS1101	Communicate English	E1-S1	2
2	HS1102	Communicate English Lab	E1-S1	1
3	HS110x	HASS-II	E1-S1	3
4	BM2001	Managerial Economics and Financial Analysis (HASS-III)	E2-S2	3
5	HS320x	HASS-IV	E3-S2	3
			Total	12

Credits required for Mandatory courses as per AICTE- 0*

S.NO.	Code	Course Title	Year-Semester	Credits
1	MC210x	MC-I	E2-S1	0
2	BSBE2201	Environmental Science	E2-S2	0
3	MC310x	MC-III	E3-S1	0
			Total	0

Credits required for Project work, Seminar& Internship as per AICTE- 15*

S.NO.	Code	Course Title	Year-Semester	Credits
1	CH2105	Seminar-I	E2-S1	1
2		Seminar-II	E3-S1	1
3	CH3206	Internship	E3-S2	3
4		Comprehensive Viva-I	E3-S2	1
5	CH4201	Major Project-II	E4-S2	8
6		Comprehensive Viva-I	E4-S2	1
			Total	15

Credits required for Professional Core Courses as per AICTE- 48*

S.NO.	Code	Course Title	Year-Semester	Credits
1	CH2101	Material& Energy balance computations.	E2-S1	4
2	CH2102	Chemical Engineering Thermodynamics.	E2-S1	4
3	CH2103	Chemical Engineering Fluid Mechanics	E2-S1	4
4	CH2104	Chemical Engineering Fluid Mechanics Lab	E2-S1	1.5
5	CH2201	Process Heat Transfer	E2-S2	4
6	CH2202	Mechanical Unit Operations	E2-S2	3
7	CH2203	Mass Transfer Operations-I	E2-S2	4
8	CH2204	Process Heat Transfer Lab	E2-S2	1.5
9	CH2205	Mechanical Unit Operations Lab	E2-S2	1.5
10	CH3101	Chemical Reaction Engineering-I	E3-S1	4
11	CH3102	Mass Transfer Operations-II	E3-S1	4
12	CH3103	General Chemical Technology (GCT)	E3-S1	3
13	CH3106	Mass Transfer Laboratory	E3-S1	1.5
14	CH3107	Energy and Environmental Engineering Laboratory	E3-S1	1.5
15	CH3201	Chemical Reaction Engineering-II	E3-S2	4

16	CH3202	Instrumentation& Process Control	E3-S2	4
17	CH3204	Chemical Reaction Engineering Laboratory	E3-S2	1.5
18	CH3205	Instrumentation& Process Control Laboratory	E3-S2	1.5
19	CH4101	Process Modeling and Simulation	E4-S1	3
20	CH4102	Transport Phenomena	E4-S1	4
21	CH4103	Design and Simulation lab	E4-S1	1.5
22	CH4104	Process Modeling and Simulation Laboratory	E4-S1	1.5
			Total	62.5

***Credits required for BTECH curriculum as per AICTE norms 150 to 160 credits but we are getting 168 credits**

Curriculum for Chemical engineering

Chemical Engineering Dept.,

RGUKT Basar Campus

A.Y. 2014-15

Curriculum for E1 Students (P2 completed students)

Semester	Course/Lab Name	Credits
E1-Sem1	Chemical Process Calculations	4
	Fluid Mechanics	4
	Mechanical Unit Operations	4
	Basic Thermodynamics	4
	Fluid Mechanics Lab	2
	Mechanical Unit Operations Lab	2
E1-Sem2	Chemical Engineering Thermodynamics	4
	Heat Transfer	4
	Mass Transfer Operations I	4
	Introduction to Reaction Engineering	4
	Heat Transfer Lab	2
	Introduction of Software Tools for Chemical Engineering (Lab)	2
E2-Sem1	Instrumentation and Process Control	4
	Chemical Reaction Engineering	4
	Mass Transfer Operations II	4
	Chemical Technology	4
	Chemical Reaction Engineering Lab	2
	Mass Transfer Operations Lab	2
E2-Sem2	Transport Phenomenon	4
	Process Equipment Design	4
	Process Modeling and Simulations	4
	Plant Design and Economics	4
	Instrumentation and Process Control Lab	2
	Process Equipment Design Lab	2
	Process Modeling and Simulations Lab	2
E3-Sem1	Basic Electrical Engineering	4
	Elective-I	4
	Elective-II	4
	Project	4
	Project	4
E3-Sem2	Bio Chemical Engineering	4
	Elective-III	4
	Elective-IV	4
	Project	4
	Project	4
E4-Sem1	Material characterization	4
	Elective-V	4

	Elective-VI	4
	Project	4
	Project	4
E4-Sem2	Environmental Science	4
	Elective-VII	4
	Elective-VIII	4
	Project	4
	Project	4

B13 Students will complete all 16 core courses by May 2017. Students have to do all other courses by Distant-mode while doing internship. Internships for E1 students will start from May-2017 to Apr 2019.

Curriculum for E2 Students (E1 completed students)

Semester	**Course/Lab Name**	**Credits**
E2-Sem1	Chemical Process Calculations	4
	Fluid Mechanics	4
	Mechanical Unit Operations	4
	Basic Thermodynamics	4
	Fluid Mechanics Lab	2
	Mechanical Unit Operations Lab	2
Winter SUM	Heat Transfer	4
	Heat Transfer Lab	2
E2-Sem2	Chemical Engineering Thermodynamics	4
	Introduction to Reaction Engineering	4
	Mass Transfer Operations-I	4
	Instrumentation & Process Control	4
	Instrumentation & Process Control Lab	2
	Introduction to Software Tools for Chemical Engineering (Lab)	2
Summer SUM-16	Mass Transfer Operations-II	4
	Chemical Technology	4
	Mass Transfer Operations Lab	2
E3-Sem1	Chemical Reaction Engineering	4
	Transport Phenomenon	4
	Plant Design and Economics	4
	Process Equipment Design	4
	Process Equipment Design Lab	2
	Chemical Reaction Engineering Lab	2
Winter SUM	Process Modeling and Simulation	4
	Process Modeling and Simulation Lab	2
E3-Sem2	Bio-Chemical Engineering	4

	Elective-I	4
	Elective-II	4
	Project	4
	Project	4
Summer SUM-17	Elective-III	4
	Elective-IV	4
E4-Sem1	Material characterization	4
	Elective-V	4
	Elective-VI	4
	Project	4
	Project	4
E4-Sem2	Environmental Science	4
	Elective-VII	4
	Elective-VIII	4
	Project	4
	Project	4

B12 Students will complete all 16 core courses by Dec 2016. Students have to do all other courses by Distant-mode while doing internship. Internships for E2 students will start from Jan-2017 to Apr 2018

Curriculum for E3 Students (E2 Completed Students)

Semester	**Course/Lab Name**	**Credits**
E3-Sem1	Mass Transfer Operations-I	4
	Instrumentation & Process Control	4
	Mechanical Unit Operations	4
	Introduction to Reaction Engineering	4
	Mechanical Unit Operations Lab	2
	Heat Transfer Lab	2
	Instrumentation & Process Control Lab	2
Winter SUM	Mass Transfer Operations-II	4
	Mass Transfer Operations Lab	2
E3-Sem2	Transport Phenomenon	4
	Process Equipment Design	4
	Plant Design and Economics	4
	Chemical Reaction Engineering	4
	Process Equipment Design Lab	2
	Chemical Reaction Engineering Lab	2
Sum-16 (June-July)	Process Modeling and Simulation	4
	Bio-Chemical Engineering	4

	Process Modeling and Simulation Lab	2
E4-Sem1	Material characterization	4
	Elective-I	4
	Elective-II	4
	Project	4
	Project	4
Win	Elective-III	4
E4-Sem2	Environmental Science	4
	Elective-IV	4
	Elective-V	4
	Project	4
	Project	4

B11 Students will complete all 16 core courses by July 2016. Students have to do all other courses by Distant-mode while doing internship. Internships for E3 students will start from Aug-2016 to Apr 2017

Curriculum for E4 Students (E3 Completed Students)

Semester	**Course/Lab Name**	**Credits**
E4-Sem1	Transport Phenomenon	4
	Process Modeling and Simulation	4
	Plant Design and Economics	4
	Bio Chemical Engineering	4
	Process Modeling and Simulation Lab	2
Winter SUM	Material characterization	4
	Elective-I	4
E4-Sem2	Elective-II	4
	Elective-III	4
	Elective-IV	4
	Project	4
	Project	4

B10 students will complete all 16 core courses by Nov 2015. Students have to do all other courses by Distant-mode while doing internship. Internships for B10 students will start from Dec-2015 to Apr 2016

List of Core Courses:

S.No	Course Full Name	Code
1	Fluid Mechanics	FM
2	Chemical Process Calculations	CPC
3	Basic Thermodynamics	BT
4	Mechanical Unit Operations	MUO
5	Chemical Engineering Thermodynamics	CETD
6	Heat Transfer	HT
7	Introduction to Reaction Engineering	IRE
8	Mass Transfer Operations-I	MTO-I
9	Instrumentation & Process Control	I&PC
10	Mass Transfer Operations-II	MTO-II
11	Chemical Reaction Engineering	CRE
12	Chemical Technology	CT
13	Transport Phenomenon	TP
14	Process Equipment Design	PED
15	Process Modeling and Simulation	PMS
16	Plant Design and Economics	PDE

Curriculum for Chemical engineering

Chemical Engineering Dept.,

RGUKT Basar Campus

A.Y. 2015-16

Curriculum for E1 Students (P2 completed students)

Semester	Course/Lab Name	Credits
E1-Sem1	Chemical Process Calculations	4
	Fluid Mechanics	4
	Mechanical Unit Operations	4
	Basic Thermodynamics	4
	Fluid Mechanics Lab	2
	Mechanical Unit Operations Lab	2
E1-Sem2	Chemical Engineering Thermodynamics	4
	Heat Transfer	4
	Mass Transfer Operations I	4
	Introduction to Reaction Engineering	4
	Heat Transfer Lab	2
	Introduction of Software Tools for Chemical Engineering (Lab)	2
E2-Sem1	Instrumentation and Process Control	4
	Chemical Reaction Engineering	4
	Mass Transfer Operations II	4
	Chemical Technology	4
	Chemical Reaction Engineering Lab	2
	Mass Transfer Operations Lab	2
E2-Sem2	Transport Phenomenon	4
	Process Equipment Design	4
	Process Modeling and Simulations	4
	Plant Design and Economics	4
	Instrumentation and Process Control Lab	2
	Process Equipment Design Lab	2
	Process Modeling and Simulations Lab	2
E3-Sem1	Basic Electrical Engineering	4
	Elective-I	4
	Elective-II	4

	Project	4
	Project	4
E3-Sem2	Bio Chemical Engineering	4
	Elective-III	4
	Elective-IV	4
	Project	4
	Project	4
E4-Sem1	Material characterization	4
	Elective-V	4
	Elective-VI	4
	Project	4
	Project	4
E4-Sem2	Environmental Science	4
	Elective-VII	4
	Elective-VIII	4
	Project	4
	Project	4

B13 Students will complete all 16 core courses by May 2017. Students have to do all other courses by Distant-mode while doing internship. Internships for E1 students will start from May-2017 to Apr 2019.

Curriculum for E2 Students (E1 completed students)

Semester	**Course/Lab Name**	**Credits**
E2-Sem1	Chemical Process Calculations	4
	Fluid Mechanics	4
	Mechanical Unit Operations	4
	Basic Thermodynamics	4
	Fluid Mechanics Lab	2
	Mechanical Unit Operations Lab	2
Winter SUM	Heat Transfer	4
	Heat Transfer Lab	2
E2-Sem2	Chemical Engineering Thermodynamics	4
	Introduction to Reaction Engineering	4
	Mass Transfer Operations-I	4
	Instrumentation & Process Control	4
	Instrumentation & Process Control Lab	2
	Introduction to Software Tools for Chemical Engineering (Lab)	2
Summer SUM-16	Mass Transfer Operations-II	4
	Chemical Technology	4
	Mass Transfer Operations Lab	2

E3-Sem1	Chemical Reaction Engineering	4
	Transport Phenomenon	4
	Plant Design and Economics	4
	Process Equipment Design	4
	Process Equipment Design Lab	2
	Chemical Reaction Engineering Lab	2
Winter SUM	Process Modeling and Simulation	4
	Process Modeling and Simulation Lab	2
E3-Sem2	Bio-Chemical Engineering	4
	Elective-I	4
	Elective-II	4
	Project	4
	Project	4
Summer SUM-17	Elective-III	4
	Elective-IV	4
E4-Sem1	Material characterization	4
	Elective-V	4
	Elective-VI	4
	Project	4
	Project	4
E4-Sem2	Environmental Science	4
	Elective-VII	4
	Elective-VIII	4
	Project	4
	Project	4

B12 Students will complete all 16 core courses by Dec 2016. Students have to do all other courses by Distant-mode while doing internship. Internships for E2 students will start from Jan-2017 to Apr 2018

Curriculum for E3 Students (E2 Completed Students)

Semester	**Course/Lab Name**	**Credits**
E3-Sem1	Mass Transfer Operations-I	4
	Instrumentation & Process Control	4
	Mechanical Unit Operations	4
	Introduction to Reaction Engineering	4
	Mechanical Unit Operations Lab	2
	Heat Transfer Lab	2
	Instrumentation & Process Control Lab	2
Winter SUM	Mass Transfer Operations-II	4
	Mass Transfer Operations Lab	2

E3-Sem2	Transport Phenomenon	4
	Process Equipment Design	4
	Plant Design and Economics	4
	Chemical Reaction Engineering	4
	Process Equipment Design Lab	2
	Chemical Reaction Engineering Lab	2
Sum-16 (June-July)	Process Modeling and Simulation	4
	Bio-Chemical Engineering	4
	Process Modeling and Simulation Lab	2
E4-Sem1	Material characterization	4
	Elective-I	4
	Elective-II	4
	Project	4
	Project	4
Win	Elective-III	4
E4-Sem2	Environmental Science	4
	Elective-IV	4
	Elective-V	4
	Project	4
	Project	4

B11 Students will complete all 16 core courses by July 2016. Students have to do all other courses by Distant-mode while doing internship. Internships for E3 students will start from Aug-2016 to Apr 2017

Curriculum for E4 Students (E3 Completed Students)

Semester	**Course/Lab Name**	**Credits**
E4-Sem1	Transport Phenomenon	4
	Process Modeling and Simulation	4
	Plant Design and Economics	4
	Bio Chemical Engineering	4
	Process Modeling and Simulation Lab	2
Winter SUM	Material characterization	4
	Elective-I	4
E4-Sem2	Elective-II	4
	Elective-III	4

	Elective-IV	4
	Project	4
	Project	4

B10 students will complete all 16 core courses by Nov 2015. Students have to do all other courses by Distant-mode while doing internship. Internships for B10 students will start from Dec-2015 to Apr 2016

List of Core Courses:

S.No	Course Full Name	Code
1	Fluid Mechanics	FM
2	Chemical Process Calculations	CPC
3	Basic Thermodynamics	BT
4	Mechanical Unit Operations	MUO
5	Chemical Engineering Thermodynamics	CETD
6	Heat Transfer	HT
7	Introduction to Reaction Engineering	IRE
8	Mass Transfer Operations-I	MTO-I
9	Instrumentation & Process Control	I&PC
10	Mass Transfer Operations-II	MTO-II
11	Chemical Reaction Engineering	CRE
12	Chemical Technology	CT
13	Transport Phenomenon	TP
14	Process Equipment Design	PED
15	Process Modeling and Simulation	PMS
16	Plant Design and Economics	PDE

Courses offered in AY.16-17 in Chemical engineering

E1:

E1-Semester-I **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits (C)
1		CY1001	Chemistry	4-0	4
2		CS1101	Programming in C	4-0	4
3		MA1101	Mathematics-I	4-0	4
4		HS1001	English	4-0	3
5		CH1101	Engineering Thermodynamics	4-0	4
6		CE1601	Engineering Drawing	1-2	2
7		CY1601	Chemistry Lab	0-3	2
8		CS1701	Programming in C Lab	0-3	2
					25

E1-Semester-II **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits (C)
1		MA1201	Mathematics-II	4-0	4
2		PH1001	Physics	4-0	4
3		CS1201	Scripting Languages	4-0	3
4		EE1001	Basic Electrical and Electronics Engineering	4-0	4
5		CH1201	Chemical Process Calculations	4-0	4
6		PH1601	Physics Lab	0-3	2
7		EE1601	Basic Electrical and Electronics Engineering Lab	0-3	2
8		HS1601	English Communication Lab	0-3	2
					25

E2:

E2-Semester-I **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits (C)
1		CY2001	Organic Chemistry	4-0	4
2		CE2001	Environmental Science	4-0	3
		MA2104	Mathematics-III	4-0	4
3		CH2101	Chemical Engineering Fluid Mechanics	4-0	4
4		CH2102	Chemical Engineering Thermodynamics	4-0	4
5		CY2601	Organic Chemistry Lab	0-3	2
6		CH2701	Chemical Engineering Fluid Mechanics Lab	0-3	2
7		CH2901	Seminar-I		1
					24

E2-Semester-II **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits(C)
1		CY2002	Analytical Chemistry	4-0	3
2		MM2205	Material science	4-0	4
3		CH2201	Process Heat Transfer	4-0	4
4		CH2202	Mechanical Unit Operations	4-0	4
5		CH2203	Mass Transfer Operations-I	4-0	4
6		CH2801	Process Heat Transfer Lab	0-3	2
7		CH2802	Mechanical Unit Operations Lab	0-3	2
8		CH2902	Seminar-II		1
					24

E3:

E3-Semester-I **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits(C)
1		BM3001	Managerial Economics and Financial Analysis	4-0	3
2		CH3101	Mass Transfer Operations-II	4-0	4
3		CH3102	Instrumentation & Process Control	4-0	4
4		CH3103	Environmental Pollution & Control Engineering	4-0	4
5		CH3104	Chemical Reaction Engineering-I	4-0	4
6		CH3701	Mass Transfer Operations Lab	0-3	2
7		CH3702	Instrumentation & Process Control Lab	0-3	2
8		CH3901	Seminar-II		1
					24

E3-Semester-II **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits (C)
1		CS3001	Object Oriented Programming	4-0	4
2		CH3201	Chemical Reaction Engineering-II	4-0	4
3		CH3202	General Chemical Technology	4-0	4
4		CH3203	Energy engineering	4-0	4
5		CH3204	Plant Design and Economics	4-0	3
6		CS3601	Object Oriented Programming Lab	0-3	2
7		CH3801	Chemical Reaction Engineering Lab	0-3	2
8		CH3902	Seminar-III		1
9		CH3000	Comprehensive Viva Voce-I		1
					25

E4:

E4-Semester-I **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits(C)
1		CH3900	Summer Internship		6
2		CH4101	Process Equipment Design	4-0	4
3		CH4102	Process Modeling and Simulation	4-0	4
4		CH4103	Transport Phenomena	4-0	4
5			Elective-I	4-0	3
6		CH4701	Process Equipment Design & Drawing Lab	0-3	2
7		CH4702	Process Simulation Lab	0-3	2
8		CH4700	Major Project		4
					29

E4-Semester-II **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits(C)
1			Open Elective-I	4-0	3
2			Elective-II	4-0	3
3		CH4800	Major Project		12
4		CH4000	Comprehensive Viva Voce-II		1
					19

List of Electives (Department of Chemical engineering)

S.No	Elective	Subject Code	Subject Name	(L-T)-P	Credits (C)
1	Elective-I	CH4401	Process Optimization	4-0	3
2		CH4402	Novel Separation Processes	4-0	3
3		CH4403	Polymer science and Engineering	4-0	3
4	Elective-II	CH4501	Petroleum Refinery Engineering	4-0	3
5		CH4502	Technology of Pharmaceuticals and Fine Chemicals	4-0	3
6		CH4503	Computational Fluid Dynamics	4-0	3

Open Elective: Under Open Elective category a student should register for any Subject offered by other departments.

Courses offered in AY.17-18 in Chemical engineering

E1:

E1-Semester-I **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits (C)
1		CY1001	Chemistry	4-0	4
2		CS1101	Programming in C	4-0	4
3		MA1101	Mathematics-I	4-0	4
4		HS1001	English	4-0	3
5		CH1101	Engineering Thermodynamics	4-0	4
6		CE1601	Engineering Drawing	1-2	2
7		CY1601	Chemistry Lab	0-3	2
8		CS1701	Programming in C Lab	0-3	2
					25

E1-Semester-II **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits (C)
1		MA1201	Mathematics-II	4-0	4
2		PH1001	Physics	4-0	4
3		CS1201	Scripting Languages	4-0	3
4		EE1001	Basic Electrical and Electronics Engineering	4-0	4
5		CH1201	Chemical Process Calculations	4-0	4
6		PH1601	Physics Lab	0-3	2
7		EE1601	Basic Electrical and Electronics Engineering Lab	0-3	2
8		HS1601	English Communication Lab	0-3	2
					25

E2:

E2-Semester-I **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits (C)
1		CY2001	Organic Chemistry	4-0	4
2		CE2001	Environmental Science	4-0	3
		MA2104	Mathematics-III	4-0	4
3		CH2101	Chemical Engineering Fluid Mechanics	4-0	4
4		CH2102	Chemical Engineering Thermodynamics	4-0	4
5		CY2601	Organic Chemistry Lab	0-3	2
6		CH2701	Chemical Engineering Fluid Mechanics Lab	0-3	2
7		CH2901	Seminar-I		1
					24

E2-Semester-II **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits(C)
1		CY2002	Analytical Chemistry	4-0	3
2		MM2205	Material science	4-0	4
3		CH2201	Process Heat Transfer	4-0	4
4		CH2202	Mechanical Unit Operations	4-0	4
5		CH2203	Mass Transfer Operations-I	4-0	4
6		CH2801	Process Heat Transfer Lab	0-3	2
7		CH2802	Mechanical Unit Operations Lab	0-3	2
8		CH2902	Seminar-II		1
					24

E3:

E3-Semester-I **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits(C)
1		BM3001	Managerial Economics and Financial Analysis	4-0	3
2		CH3101	Mass Transfer Operations-II	4-0	4
3		CH3102	Instrumentation & Process Control	4-0	4
4		CH3103	Environmental Pollution & Control Engineering	4-0	4
5		CH3104	Chemical Reaction Engineering-I	4-0	4
6		CH3701	Mass Transfer Operations Lab	0-3	2
7		CH3702	Instrumentation & Process Control Lab	0-3	2
8		CH3901	Seminar-II		1
					24

E3-Semester-II **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits (C)
1		CS3001	Object Oriented Programming	4-0	4
2		CH3201	Chemical Reaction Engineering-II	4-0	4
3		CH3202	General Chemical Technology	4-0	4
4		CH3203	Energy engineering	4-0	4
5		CH3204	Plant Design and Economics	4-0	3
6		CS3601	Object Oriented Programming Lab	0-3	2
7		CH3801	Chemical Reaction Engineering Lab	0-3	2
8		CH3902	Seminar-III		1
9		CH3000	Comprehensive Viva Voce-I		1
					25

E4:

E4-Semester-I **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits(C)
1		CH3900	Summer Internship		6
2		CH4101	Process Equipment Design	4-0	4
3		CH4102	Process Modeling and Simulation	4-0	4
4		CH4103	Transport Phenomena	4-0	4
5			Elective-I	4-0	3
6		CH4701	Process Equipment Design & Drawing Lab	0-3	2
7		CH4702	Process Simulation Lab	0-3	2
8		CH4700	Major Project		4
					29

E4-Semester-II **B.Tech Chemical Engineering**

S.No	Category	Subject Code	Subject Name	(L-T)-P	Credits(C)
1			Open Elective-I	4-0	3
2			Elective-II	4-0	3
3		CH4800	Major Project		12
4		CH4000	Comprehensive Viva Voce-II		1
					19

List of Electives (Department of Chemical engineering)

S.No	Elective	Subject Code	Subject Name	(L-T)-P	Credits (C)
1	Elective-I	CH4401	Process Optimization	4-0	3
2		CH4402	Novel Separation Processes	4-0	3
3		CH4403	Polymer science and Engineering	4-0	3
4	Elective-II	CH4501	Petroleum Refinery Engineering	4-0	3
5		CH4502	Technology of Pharmaceuticals and Fine Chemicals	4-0	3
6		CH4503	Computational Fluid Dynamics	4-0	3

Open Elective: Under Open Elective category a student should register for any Subject offered by other departments.

Department of CSE

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E1 SEM 1 (B12)								
S.NO	ourse Cod	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	MA1101	Mathematics-I	4-0-0	4				
2	CS1101	Programming in C	4-0-0	4				
3	CS1102	IT Workshop	4-0-0	4				
4	CY1101	Chemistry	4-0-0	4				
5	CS1701	Programming in C lab	0-1-2	2				
6	CY1701	Chemistry Lab	0-1-2	2				
7								
8								
9								

E1 SEM 2 (B12)					
S.NO	Course Code	Course	L-T-P	Credits	A
1	CS1201	Data Structures through C(DS)	4-0-0	4	
2	PH1001	Physics	4-0-0	4	
3	MA1201	Maths-II	4-0-0	4	
4	EE1001	Basic Electrical and Electronics Engineering(BEE)	4-0-0	4	
5	HS1001	English for Communication	4-0-0	4	
6	HS1801	English for Communication Lab	0-1-2	2	
7	CS1801	Data Structures through C Lab	0-1-2	2	
8	PH1601	Physics Lab	0-1-2	2	
9	EE1601	Basic Electrical and Electronics Engineering lab	0-1-2	2	

E2 SEM 1 (B11)								
S.NO	ourse Cod	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS2101	DataBase Management Systems	4-0-0	4				
2	CS2102	Digital Logic Design	4-0-0	4				
3	MA2101	Discrete Structures	4-0-0	4				
4	EC2201	Basic Electronics	4-0-0	4				
5	CS2105	Object Oriented Programming	4-0-0	4				
6	CS2701	DataBase Management Systems Lab	0-1-2	2				
7	CS2702	Digital Logic Design Lab	0-1-2	2				
8	CS2705	Object Oriented Programming Lab	0-1-2	2				
9	EC2701	Basic Electronics Lab	0-1-2	2				

E2 SEM 2 (B11)					
S.NO	Course Code	Course	L-T-P	Credits	A
1	CS2202	Design and Analysis of Algorithms	4-0-0	4	
2	CS2203	COMPUTER ORGANIZATION AND ARCHITECTURE	4-0-0	4	
3	CS2204	Formal Language and Automata Theory	4-0-0	4	
4	CS2201	Data Structures through C	4-0-0	4	
5	MA2201	Probability and Statistics	4-0-0	4	
6	CS2803	COMPUTER ORGANIZATION AND ARCHITECTURE lab	0-1-2	2	
7	CS2801	Data Structures through C lab	0-1-2	2	
8	CS2901	Seminar-I	0-0-1	1	

E3 SEM 1 (B10)								
S.NO	ourse Cod	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS3106	Formal Languages & Automata Theory	4-0-0	4				
2	CS4405	Object Oriented Programming	4-0-0	4				
3	CS3101	Computer Organization & Architecture	4-0-0	4				
4	CS4705	Object Oriented Programming lab	0-1-2	2				
5	CS3701	Computer Organization & Architecture Lab	0-1-2	2				
6	CS3702	Database Management Systems Lab	0-1-2	2				
7								
8								

E3 SEM 2 (B10)					
S.NO	Course Code	Course	L-T-P	Credits	A
1	CS3203	Operating Systems	4-0-0	4	
2	CS3204	Linux Programming	4-0-0	4	
3	CS3202	Compiler Design	4-0-0	4	
4	CS3201	Web Technologies	4-0-0	4	
5	BM3001	Managerial Economics & Fundamental Analysis	4-0-0	4	
6	CS3803	Operating Systems & Linux Programming lab	0-1-2	2	
7	CS3801	Web Technologies lab	0-1-2	2	
8	CS3901	Seminar-II	0-0-1	1	
	CS3000	Comprehensive VIVA-I		1	

E4 SEM 1 (B09)								
S.NO	ourse Cod	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS4407	Artificial Intilligence	4-0-0	4				
2	CS4101	Computer Networks	4-0-0	4				
3	BM4101	Management Science	4-0-0	4				
4	CS4102	IT Workshop	4-0-0	4				
5	CS4405	Object Oriented Programming	4-0-0	4				
6	CS4701	Computer Networks Lab	0-1-2	2				
7	CS4705	Object Oriented Programming Lab	0-1-2	2				
	CS4700	Project-!		4				

E4 SEM 2 (B09)					
S.NO	Course Code	Course	L-T-P	Credits	A
1	CS4202	Data Mining	4-0-0	4	
2	CS4800	Project-II		16	
3	CS4000	Comprehensive viva		2	
4		Free Elective	3-0-0	3	
5					
6					
7					

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E1 SEM 1 (B13)								
S.NO	ourse Cod	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	MA1101	Mathematics-I	4-0-0	4				
2	CS1101	Programming in C	4-0-0	4				
3	CS1102	IT Workshop	4-0-0	4				
4	CY1101	Chemistry	4-0-0	4				
5	CS1701	Programming in C lab	0-1-2	2				
6	CY1701	Chemistry Lab	0-1-2	2				
7								
8								
9								

E1 SEM 2 (B13)				
S.NO	Course Code	Course	L-T-P	Credits
1	CS1201	Data Structures through C(DS)	4-0-0	4
2	PH1001	Physics	4-0-0	4
3	MA1201	Maths-II	4-0-0	4
4	EE1001	Basic Electrical and Electronics Engineering(BEE)	4-0-0	4
5	HS1001	English for Communication	4-0-0	4
6	HS1801	English for Communication Lab	0-1-2	2
7	CS1801	Data Structures through C Lab	0-1-2	2
8	PH1601	Physics Lab	0-1-2	2
9	EE1601	Basic Electrical and Electronics Engineering lab	0-1-2	2

E2 SEM 1 (B12)								
S.NO	ourse Cod	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS2101	DataBase Management Systems	4-0-0	4				
2	CS2102	Digital Logic Design	4-0-0	4				
3	MA2101	Discrete Structures	4-0-0	4				
4	EC2201	Basic Electronics	4-0-0	4				
5	CS2105	Object Oriented Programming	4-0-0	4				
6	CS2701	DataBase Management Systems Lab	0-1-2	2				
7	CS2702	Digital Logic Design Lab	0-1-2	2				
8	CS2705	Object Oriented Programming Lab	0-1-2	2				
9	EC2701	Basic Electronics Lab	0-1-2	2				

E2 SEM 2 (B12)				
S.NO	Course Code	Course	L-T-P	Credits
1	CS2202	Design and Analysis of Algorithms	4-0-0	4
2	CS2203	COMPUTER ORGANIZATION AND ARCHITECTURE	4-0-0	4
3	CS2204	Formal Language and Automata Theory	4-0-0	4
4	CS2201	Data Structures through C	4-0-0	4
5	MA2201	Probability and Statistics	4-0-0	4
6	CS2803	COMPUTER ORGANIZATION AND ARCHITECTURE lab	0-1-2	2
7	CS2801	Data Structures through C lab	0-1-2	2
8	CS2901	Seminar-I	0-0-1	1

E3 SEM 1 (B11)								
S.NO	ourse Cod	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS3106	Formal Languages & Automata Theory	4-0-0	4				
2	CS4405	Object Oriented Programming	4-0-0	4				
3	CS3101	Computer Organization & Architecture	4-0-0	4				
4	CS4705	Object Oriented Programming lab	0-1-2	2				
5	CS3701	Computer Organization & Architecture Lab	0-1-2	2				
6	CS3702	Database Management Systems Lab	0-1-2	2				
7								
8								

E3 SEM 2 (B11)				
S.NO	Course Code	Course	L-T-P	Credits
1	CS3203	Operating Systems	4-0-0	4
2	CS3204	Linux Programming	4-0-0	4
3	CS3202	Compiler Design	4-0-0	4
4	CS3201	Web Technologies	4-0-0	4
5	BM3001	Managerial Economics & Fundamental Analysis	4-0-0	4
6	CS3803	Operating Systems & Linux Programming lab	0-1-2	2
7	CS3801	Web Technologies lab	0-1-2	2
8	CS3901	Seminar-II	0-0-1	1
	CS3000	Comprehensive VIVA-I		1

E4 SEM 1 (B10)								
S.NO	ourse Cod	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS4407	Artificial Intilligence	4-0-0	4				
2	CS4101	Computer Networks	4-0-0	4				
3	BM4101	Management Science	4-0-0	4				
4	CS4102	IT Workshop	4-0-0	4				
5	CS4405	Object Oriented Programming	4-0-0	4				
6	CS4701	Computer Networks Lab	0-1-2	2				
7	CS4705	Object Oriented Programming Lab	0-1-2	2				
	CS4700	Project-!		4				

E4 SEM 2 (B10)				
S.NO	Course Code	Course	L-T-P	Credits
1	CS4202	Data Mining	4-0-0	4
2	CS4800	Project-II		16
3	CS4000	Comprehensive viva		2
4		Free Elective	3-0-0	3
5				
6				
7				

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E1 SEM 1 (B14)

S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS1101	Programming in C	4-0-0	4				
2	CY1001	Chemistry	4-0-0	4				
3	MA1101	Mathematics-I	4-0-0	4				
4	ME1001	Engineering Mechanics	4-0-0	4				
5	EC1101	Network Analysis	4-0-0	4				
6	CS1701	Programming in C Lab	0-1-2	2				
7	CY1601	Chemistry Lab	0-1-2	2				
8	HS1101	FC - Communication Skills 1	2-0-0	1				
9								

E1 SEM 2 (B14)

S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year
1	CS1201	Data structures	4-0-0	4		
2	PH1001	Physics	4-0-0	4		
3	MA1201	Mathematics-II	4-0-0	4		
4	EC1208	Basic Electronics	4-0-0	4		
5	HS1001	English	3-0-0	3		
6	CS1802	Data structures Lab	0-1-2	2		
7	PH1601	Physics Lab	0-1-2	2		
8	HS1601	English lab	0-1-2	2		
9	HS1201	Communication Skills-II	2-0-0	1		

E2 SEM 1 (B13)

S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	MA2101	Discrete Structures	4-0-0	4				
2	CS2101	Digital Logic Design	4-0-0	4				
3	CS2102	Design and Analysis of Algorithms	4-0-0	4				
4	CS2103	Scripting Languages	4-0-0	4				
5	CS2104	Database Management System	4-0-0	4				
6	CS2701	Digital Logic Design Lab	0-1-2	2				
7	CS2702	Database Management System Lab	0-1-2	2				
8	CS2901	Seminar-I	0-0-1	1				
9	HS2101	Soft Skills-I	2-0-0	1				

E2 SEM 2

S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year
1	MA2201	Probability and Statistics	4-0-0	4		
2	BSBE2001	Environmental Science	3-0-0	3		
3	CS2201	Computer Organization and Architecture	4-0-0	4		
4	CS2202	Formal Languages and Automata Theory	4-0-0	4		
5	CS2203	Object Oriented Programming	4-0-0	4		
6	CS2801	Computer Organization and Architecture Lab	0-1-2	2		
7	CS2803	Object Oriented Programming Lab	0-1-2	2		
8	BM2101	PERSONALITY DEVELOPMENT-1	2-0-0	1		
9	CS2902	Seminar-II	0-0-1	1		

E3 SEM 1 (B12)

S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS3101	Artificial Intelligence	4-0-0	4				
2	CS3102	Compiler Design	4-0-0	4				
3	CS3103	Operating Systems	4-0-0	4				
4	CS3104	Web Technologies	4-0-0	4				
5	BSBE3001	Environmental Science	3-0-0	3				
6	CS3701	Operating Systems Lab	0-1-2	2				
7	CS3702	Web Technologies Lab	0-1-2	2				
8	CS3901	Seminar-II	0-0-1	1				
9	BM3101	FC - Personality Development	2-0-0	1				

E3 SEM 2

S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year
1	CS3201	Principle of Programming Languages	4-0-0	4		
2	CS3202	Linux Programming	4-0-0	4		
3	CS3203	Data Mining	4-0-0	4		
4	CS3204	Computer Networks	4-0-0	4		
5	CS3205	Software Engineering	4-0-0	4		
6	HS3201	Soft Skills	2-0-0	1		
7	CS3803	Data Mining Lab	0-1-2	2		
8	CS3805	Software Engineering Lab	0-1-2	2		
9	CS3902	Seminar-III	0-0-1	1		
	CS3000	Comprehensive Viva-I		1		

E4 SEM 1 (B11)

S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS3900	Summer Internship		6				
2	CS4101	Artificial Intelligence	4-0-0	4				
3	CS4102	Data Mining	4-0-0	4				
4	CS4103	Computer Networks	4-0-0	4				
5	CS4701	Data Mining Lab	0-1-2	2				
6	CS4700	Project		4				
7								
8								
9								

E4 SEM 2

S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year
1		FE-Free Elective	3-0-0	3		
2	CS4000	Comprehensive VIVA		1		
3	CS4800	project		15		
4						
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E1 SEM 1 (B15)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CY1001	Chemistry	4-0-0	4				
2	MA1101	Mathematics-I	4-0-0	4				
3	ME1001	Engineering Mechanics	4-0-0	4				
4	CS1101	Programming in C	4-0-0	4				
5	EC1101	Network Analysis	4-0-0	4				
6	HS1101	Communication Skills-I	2-0-0	1				
7	CS1701	Programming in C Lab	0-0-3	2				
8	CY1601	Chemistry Lab	0-0-3	2				
9								

E1 SEM 2					
S.NO	Course Code	Course	L-T-P	Credits	Activiti be Emp Entrep Skill c
1	CS1201	Data Structures	4-0-0	4	
2	PH1001	Physics	4-0-0	4	
3	MA1201	Mathematics-II	4-0-0	4	
4	EC1201	Basic Electronics	4-0-0	4	
5	HS1001	English for Communication	3-0-0	3	
6	CS1801	Data Structures Lab	0-0-3	2	
7	PH1601	Physics Lab	0-0-3	2	
8	HS1601	English for Communication lab	0-0-3	2	
9	HS1201	Communication Skills-II	2-0-0	1	

E2 SEM 1(B14)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	MA2101	Discrete Structures	4-0-0	4				
2	CS2101	Digital Logic Design	4-0-0	4				
3	CS2102	Design & Analysis of Algorithms	4-0-0	4				
4	CS2103	Scripting Languages	4-0-0	4				
5	CS2104	Database Management Systems	4-0-0	4				
6	CS2701	Digital Logic Design Lab	0-1-2	2				
7	CS2704	Database Management Systems lab	0-1-2	2				
8	EC2703	Basic Electronics Lab	0-1-2	2				
9	HS2101	Soft Skills-I	2-0-0	1				
10	CS2901	Seminar-I	0-0-1	1				

E2 SEM 2					
S.NO	Course Code	Course	L-T-P	Credits	Activiti be Emp Entrep Skill c
1	MA2201	Probability and Statistics	4-0-0	4	
2	CS2201	Computer Organization and Architecture	4-0-0	4	
3	CS2202	Formal Languages and Automata Theory	4-0-0	4	
4	CS2203	Object Oriented Programming	4-0-0	4	
5	CS2801	Computer Organization and Architecture Lab	0-0-3	2	
6	CS2803	Object Oriented Programming Lab	0-0-3	2	
7	BSBE2001	Environmental Science	3-0-0	3	
8	BM2201	Personality Development-I	2-0-0	1	
9	CS2902	Seminar-II	0-0-1	1	

E3 SEM 1 (B13)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS3101	Artificial Intelligence	4-0-0	4				
2	CS3102	Compiler Design	4-0-0	4				
3	CS3103	Operating Systems	4-0-0	4				
4	CS3104	Web Technologies	4-0-0	4				
5	EC3201	Microprocessors & Microcontrollers	4-0-0	4				
6	CS3703	Operating Systems lab	0-1-2	2				
7	CS3704	Web Technologies lab	0-1-2	2				
8	BM3101	Personality Development-II	2-0-0	1				
9	CS3901	Seminar-III	0-0-1	1				

E3 SEM 2					
S.NO	Course Code	Course	L-T-P	Credits	Activiti be Emp Entrep Skill c
1	CS3201	Principle of Programming Languages	4-0-0	4	
2	CS3202	Linux Programming	4-0-0	4	
3	CS3203	Data Mining	4-0-0	4	
4	CS3204	Computer Networks	4-0-0	4	
5	CS3205	Software Engineering	4-0-0	4	
6	CS3803	Data Mining Lab	0-1-2	2	
7	CS3805	Software Engineering Lab	0-1-2	2	
8	HS3201	Soft Skills - II	2-0-0	1	
9	CS3000	Comprehensive Viva-I		1	
10	CS3902	Seminar-IV	0-0-1	1	

E4 SEM 1 (B12)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS3900	Summer Internship		6				
2	BM4001	Managerial Economics & Fundamental Analysis	4-0-0	4				
3	CS4101	Mobile Computing	4-0-0	4				
4	CS4102	Information Security	4-0-0	4				
5	CS4401	Pattern Recognition & Its applications	4-0-0	4				
6	CS4411	Data Analytics	4-0-0	4				
7								
8								
9								

E4 SEM 2					
S.NO	Course Code	Course	L-T-P	Credits	Activiti be Emp Entrep Skill c
1	CS4800	Project		16	
2	BM4501	Foundations of Management	3-0-0	3	
3	BM4502	Entrepreneurship and New Ventures	3-0-0	3	
4	BM4503	Intellectual Property Rights	3-0-0	3	
5	BSBE4501	Sustainable Technology	3-0-0	3	
6	BSBE4503	Biomaterials	3-0-0	3	
7	CH4501	Polymer Science and Engineering	3-0-0	3	
8	MM4501	Fatigue Creep Fracture	3-0-0	3	
9	CS4000	Comprehensive Viva-II		1	

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E1 SEM 1 (B16)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	MA1101	Mathematics - I	4-0-0	4				
2	CY1001	Chemistry - I	4-0-0	4				
3	CS1001	Programming for Problem Solving	3-0-0	3				
4	CY1601	Chemistry - I Lab	0-0-3	1.5				
5	ME1001	Engineering Workshop	2-0-0	2				
6	ME1601	Engineering Workshop Lab	0-0-2	1				
7	HS1101	Communication Skills - I	2-0-0	0				
8	CS1601	Programming for Problem Solving Lab	0-0-4	2				
9								

E1 SEM		
S.NO	Course Code	Course
1	MA1201	Mathematics - II
2	PH1001	Physics
3	CE1001	Engineering Graphics
4	HS1001	English
5	EE1001	Basic Electrical Engineering
6	HS1201	Communication Skills-II
7	PH1601	Physics Lab
8	HS1601	English Lab
9	EE1601	Basic Electrical Engineering Lab

E2 SEM 1 (B15)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	MA2101	Discrete Structures	4-0-0	4				
2	CS2101	Digital Logic Design	4-0-0	4				
3	CS2102	Design and Analysis of Algorithms	4-0-0	4				
4	CS2103	Scripting Languages	4-0-0	4				
5	CS2104	Database Management System	4-0-0	4				
6	EC2703	Basic Electronics Lab	0-0-3	2				
7	CS2701	Digital Logic Design Lab	0-0-3	2				
8	CS2704	Database Management System Lab	0-0-3	2				
9	CS2901	Seminar-I	0-0-1	1				
10	HS2101	Soft Skills-I	2-0-0	1				

E2 SEM		
S.NO	Course Code	Course
1	MA2201	Probability and Statistics
2	BSBE2001	Environmental Science
3	CS2201	Computer Organization and Architecture
4	CS2202	Formal Languages and Automata Theory
5	CS2203	Object Oriented Programming structures through Java
6	BM2201	Personality Development-I
7	CS2801	Computer Organization and Architecture Lab
8	CS2803	Object Oriented Programming structures through Java Lab
9	CS2902	Seminar-II

E3 SEM 1 (B14)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS3101	Artificial Intelligence	4-0-0	4				
2	CS3102	Compiler Design	4-0-0	4				
3	CS3103	Operating Systems	4-0-0	4				
4	CS3104	Web Technologies	4-0-0	4				
5	EC3105	Microprocessor and Microcontrollers	4-0-0	4				
6	CS3703	Operating Systems Lab	0-0-3	2				
7	CS3704	Web Technologies Lab	0-0-3	2				
8	BM3101	Personality Development-II	2-0-0	1				
9	CS3901	Seminar-III	0-0-1	1				

E3 SEM		
S.NO	Course Code	Course
1	CS3201	Principle of Programming Languages
2	CS3202	Linux Programming
3	CS3203	Data Mining
4	CS3204	Computer Networks
5	CS3205	Software Engineering
6	CS3803	Data Mining Lab
7	CS3805	Software Engineering Lab
8	HS3201	Soft Skills-II
9	CS3902	Seminar-IV
10	CS3000	Comprehensive Viva-I

E4 SEM 1 (B13)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS3900	Summer Internship		6				
2	BM4001	Managerial Economics and Financial Analysis	4-0-0	4				
3	CS4101	Mobile Computing	4-0-0	4				
4	CS4102	Information Security	4-0-0	4				
5	CS4408	Deep Learning	4-0-0	4				
6	CS4411	Data analytics	4-0-0	4				
7								
8								
9								

E4 SEM		
S.NO	Course Code	Course
1	CS4800	Project
2	CS4000	Comprehensive Viva-II
3	BM4501	Foundations of Management
4	BM4502	Entrepreneurship and New Ventures
5	BM4503	Intellectual Property Rights
6	BSBE4501	Sustainable Technology
7	BSBE4502	Pharmaceutical Technology
8	BSBE4503	Biomaterials
9	MM4501	Fatigue Creep Fracture
10	CH4501	Polymer Science and Engineering
11	CH4502	Fluidization Engineering
12	EC4501	Biomedical Signal Processing

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E1 SEM 1 (B17)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	19CS1101	Programming for Problem Solving	3-0-0	3				
2	19ME1102	Engineering Workshop(Theory)	2-0-2					
3		Engineering Workshop Lab		3				
4	19CY1101	Chemistry-I	4-0-0	4				
5	19MA1102	Calculus	2-0-0	2				
6	19MA1101	Linear Algebra	3-0-0	3				
7	18HS1102	Communication Skills-I	2-0-0	0				
8	18BM1105	Indian Constitution	3-0-0	0				
9	19CS1701	Programming for Problem Solving Lab	0-0-4	2				
10	19CY1701	Chemistry-I Lab	0-0-3	1.5				

E1 SEM 2				
S.NO	Course Code	Course	L-T-P	Credits
1	19CS1802	IT Workshop	0-0-3	1.5
2	19EE1202	Basic Electrical Engineering	4-0-0	4
3	19CE1801	Engineering Graphics	0-0-6	3
4	19PH1201	Physics-I	4-0-0	4
5	18MA1201	Differential Equations & Vector Calculus	4-0-0	4
6	18HS1201	English	2-0-0	2
7	18HS1202	Communication Skills-II	2-0-0	0
8	19EE1802	Basic Electrical Engineering Lab	0-0-2	1
9	19PH1802	Physics-I lab	0-0-3	1.5
10	18HS1801	English Lab	0-0-2	1

E2 SEM 1 (B16)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	19CS2101	Data structure & Algorithms(DS)	3-0-0	3				
2	19CS2102	Discrete Mathematics(DM)	4-0-0	4				
3	19CS2702	IT Workshop	0-0-3	1.5				
4	19EC2105	Analog Electronic circuits(AEC)	4-0-0	3				
5	19EC2101	Digital Electronic Circuits(DEC)	3-0-0	3				
6	19MA2102	Probability and Statistics(PS)	4-0-0	4				
7	19HS2101	Essence of Indian Traditional Knowledge	2-0-0	0				
8	19CS2701	Data structure & Algorithms lab(DS lab)	0-0-4	2				
9	19EC2703	Analog Electronic circuits lab(AEC)	0-0-3	1.5				
10	19EC2701	Digital Electronic Circuits lab(DEC)	0-0-2	1				

E2 SEM 2				
S.NO	Course Code	Course	L-T-P	Credits
1	19CS2201	Computer Organization & Architecture	3-0-0	3
2	19CS2202	Database Management Systems	3-0-0	3
3	19CS2203	Design & Analysis of Algorithms	3-0-0	3
4	19CS2204	Data Analytics	3-0-0	3
5		Managerial Economics	3-0-0	3
6	18BS2201	Environmental Sciences	3-0-0	0
7	19CS2801	Computer Organization & Architecture lab	0-0-4	2
8	19CS2802	Database Management Systems lab	0-0-4	2
9	19CS2803	Design & Analysis of Algorithms lab	0-0-4	2

E3 SEM 1 (B15)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS3101	Artificial Intelligence	4-0-0	4				
2	CS3102	Compiler Design	4-0-0	4				
3	CS3103	Operating Systems	4-0-0	4				
4	CS3104	Web Technologies	4-0-0	4				
5	EC3201	Microprocessor and Microcontrollers	4-0-0	4				
6	CS3703	Operating Systems Lab	0-0-3	2				
7	CS3704	Web Technologies Lab	0-0-3	2				
8	CS3901	Seminar-III	0-0-1	1				
9	BM3101	Personality Development-II	2-0-0	1				

E3 SEM 2				
S.NO	Course Code	Course	L-T-P	Credits
1	CS3201	Principle of Programming Languages	4-0-0	4
2	CS3202	Linux Programming	4-0-0	4
3	CS3203	Data Mining	4-0-0	4
4	CS3204	Computer Networks	4-0-0	4
5	CS3205	Software Engineering	4-0-0	4
6	CS3803	Data Mining Lab	0-0-3	2
7	CS3805	Software Engineering Lab	0-0-3	2
8	HS3201	Soft Skills-II	0-1-1	1
9	CS3902	Seminar-IV	0-0-1	1
10	CS3000	Comprehensive Viva-I		1

E4 SEM 1 (B14)								
S.NO	Course Code	Course	L-T-P	Credits	Activities with direct bearing on Employability/ Entrepreneurship/ Skill development	Is the syllabus modified wrt previous academic year	% of syllabus revised	Document of the revised syllabus
1	CS3900	Summer Internship		6				
2	BM4001	Managerial Economics & Financial analysis	4-0-0	4				
3	CS4101	Mobile computing	4-0-0	4				
4	CS4102	Information Security	4-0-0	4				
5	CS4411	Elective-II(Data Analytics)	4-0-0	4				
6	CS4418	Elective-II(Introduction to Block Chain Technology)	4-0-0	4				
7								
8								
9								

E4 SEM 2				
S.NO	Course Code	Course	L-T-P	Credits
1	CS4800	Project		16
2	CS4000	Comprehensive Viva-II		1
3		Free Elective	3-0-0	3

Rajiv Gandhi University of Knowledge and Technology

Basar, Mudhole, Adilabad – 504107

B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

Regulations -2014

Rajiv Gandhi University of Knowledge and Technology

Basar, Mudhole, Adilabad – 504107

B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

I YEAR **I SEMISTER**

Code	Subject	L-T	P	C
EC1101	Network Analysis	4	-	4
PH1001	Engineering Physics	4	-	4
MA110 1	Mathematics-1	4	-	4
CS1101	Programming in C	4	-	4
HS1001	English	4	-	3
EC1701	Network Analysis Lab	-	3	2
PH1601	Engineering Physics Lab	-	3	2
CS1701	Programming in C Lab	-	3	2
HS1101	Communication Skills-I	2	-	1
	Total	**22**	**9**	**26**

EC1101 Network Analysis

Externals: 60Marks **(For ECE & CSE-E1S1)** **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. To provide the knowledge of basic components of circuit and their relations in various forms of connection.
2. To provide the knowledge of D.C analysis of circuits.
3. To understand concept and various parameters of single phase AC circuits.
4. To understand concept of resonance and various theorems.
5. To give the knowledge of two port network and Graphs in circuit theory.

Course Outcomes:

Upon completion of course the student

1. Will be able to articulate in working of various components of a circuit.
2. Will be familiar with solving DC circuits.
3. Will have ability to analyze AC circuit and measure related parameters.
4. To solve the given circuit with various theorems and methods.
5. Ability to Express given Electrical Circuit in terms of A,B,C,D and Z,Y Parameter Model and Solve the circuits
6. To distinguish between tie set and cut set methods for solving various circuits.

UNIT- I: DC CIRCUIT ANALYSIS

R-L-C Parameters, Voltage and Current Independent and Dependent Sources, Source Transformation – V–I relationship for Passive elements, Kirchhoff's Laws, Network reduction techniques – series, parallel, series parallel, star–to-delta, delta-to-star transformation, Nodal Analysis

UNIT- II: DC TRANSIENTS

DC Transients: RL, RC and RLC, Laplace transforms and their adaptation to networks

UNIT- III: SINGLE PHASE AC CIRCUITS

Single Phase AC Circuits - R.M.S. and Average values, Form Factor, steady state analysis of series, Parallel and Series parallel Combinations of R, L and C with Sinusoidal excitation, concept of reactance, Impedance, Susceptance and Admittance – phase and phase difference, Concept of Power Factor, j-notation, complex and Polar forms of representation.

UNIT- IV: RESONANCE and NETWORK THEOREMS

Resonance – Series resonance and Parallel resonance circuits, concept of bandwidth and Q factor, Locus Diagrams for RL, RC and RLC Combinations for Various Parameters.
Network Theorems - The venin's, Norton's, Maximum Power Transfer, Superposition, Reciprocity, Tellegen's, Millman's and Compensation theorems for DC and AC excitations.

UNIT- V: TWO PORT NETWORKS and GRAPH THEORY
Two port networks: Z, Y, h and ABCD parameters
Graphs: Paths, connectedness, circuits, cutsets, trees; Matrix representation of directed graphs: incidence, cutset and circuit matrices; Methods of analysis of linear networks: nodal-cutset-mesh- and loop-analysis.**Transfer functions:** poles and zeros; Elements of Filter Theory.

TEXT BOOKS:
1. Network Theory by N.Sreenivasulu, REEM Publications
2. Circuits & Networks by A. Sudhakar and Shyammohan S Palli, Tata McGraw- Hill
3. Electric Circuits- Schuam Series

REFERENCE BOOKS:
1. Network Analysis by M.E Van Valkenberg, Prantice Hall India, 3rd Edition.
2. Electric circuit Analysis by C.L. Wadhwa, New Age international
3. Electric circuits by David A. Bell, Oxford University press

PH 1001 **ENGINEERING PHYSICS**

Externals: 60Marks **L-T-P-C***

Internals: 40Marks **4-0-0-4**

Course Objectives:

1. To inculcate in the Students a sense of yearning to learn the basic Physics behind the applications that we look around in day to day life.

2. To deliver the basic Principles of Physics that forms the basis for the development of Technology.

3. The basic details of Solid state Physics, Optics and Electrodynamics and Quantum Physics provided in a subtle fashion dealt in finer details to have strong basics in these areas.

Course Outcomes:

1. The Students would be in a position to understand the innate Physics principles that go into the day to day phenomenon specifical to Optical domain.
2. The Students would get hold of the basic Electro magnetic Wave concepts that are crucial in understanding the Communication Phenomenon.
3. The Students would have realized the difference between the Newtonian Domain(Classical Physics) and quantum domain(Quantum Mechanics) and get to know the Physics that happens at the Quantum Domain.
4. The Students would be equipped with concepts in understanding the crystals and materials from a basic point of view which form a backbone in understanding the properties exhibited by these materials.

UNIT – I

MATHEMATICAL PHYSICS (3)

1. Gradient, Divergence, Curl and their physical significance

   Scalar and Vector point Functions, Differential operator, Gradient , Physical significance, Divergence, Significance, Curl, Physical Significance, Vector Identities

1.2 Stokes theorem & Gauss theorem

   Vector Integral Theorems, Line Integral, Surface and Volume Integrals, Stokes Theorem, Gauss-Divergence Theorem, Application

1.3 Curvilinear coordinates

   Types of Coordinate systems, Polar coordinates, Cylindrical and Spherical coordinates, Equations Relating Cartesian, Spherical and Cylindrical coordinate

UNIT – II
ELECTRODYNAMICS (6)

2.1 Maxwell's Equations
Electrodynamics before Maxwell, Fixing of Ampere's Law, Maxwell Equation in matter, Boundary Conditions.

2.2 Poynting theorem and conservation laws
Continuity Equation, Poynting Theorem, Conservation Law Newton Third law in Electrodynamics

2.3 Wave equation
Wave equation, wave form Boundary conditions, Reflection and Transmission for a string

2.4 Electro Magnetic Waves in vacuum
Wave equation for E and B, Monochromatic Plane Waves, Energy and Momentum in EM Waves in vacuum

2.5 Electro Magnetic waves in Matter
Propagation in Linear Media, Reflection and Transmission at Normal Incidence Oblique Incidence

2.6 EM wave in conducting surface.

Reference Books :

1. Electrodyamics by David j.Griffiths

UNIT – III
OPTICS (12)

1. Interference by division of wave front (Biprism)
Introduction , Interference of Light Waves, Interference Pattern , Intensity Distribution, Fresnel Biprism

3.2 Interference by division of amplitude (Newton's rings)
Interference by Plane parallel Wave, Cosine Law, Interference by a film with Non-Parallel reflecting surface, Wedge, Newton's Rings.

3.3 Michelson's interferometer

Interference by Plane film illuminated by a point source, Michelson's Interferometer.

3.4 Fraunhoffer diffration (Single slit)
Introduction, Types of Diffraction,Single Slit Frauhoffer Diffraction, Position of Maxima and Minima,Graphical Method for determining roots

3.5 Frauhoffer diffraction Double slit & multiple slits
Double slit Fraunhoffer diffraction by N- Parallel slits

3.6 Diffraction Gratings, Grating and Resolving Power
Diffraction Grating, Construction of Grating, Grating Spectrum, Resolution, Resolving Power of a diffraction Grating

3.7 Fresnel diffraction and Zone Plate
Types of Diffraction, Fresnel diffraction, Fresnel Half Period zones, Zone plate Application of Zone, Lens

3.8 Production of Plane Polarised light & double refraction
Introduction , Polarisation of Light waves, Representation of various types of light, Polarization by Reflection,Brewster's Law, Laws of Malus and proof, Geometry of Calcite Crystal, Double Refraction, Nicol's Prism, Applications.

3.9 Quarter & Half – wave plate, elliptical & circular polarized lights
Huygen's Theory of Double Refraction, Quarter Wave plate, Half Wave Plate, Elliptically and Circularly Polarised light.

3.10 Production & detection of elliptical & circular Polarised lights

Elliptically polarised Light, Circularly polarised light, Conversion of Elliptically polarized light to Circularly polarised light, Analysis of polarized light of Different Kinds.

3.11 Theory of Laser
Introduction, Spontaneous Emission, Stimulated Emission, Relation between Spontaneous and Stimulated emission Probabilities, Population Inversion, Pumping, Active systems.

3.12 Different kinds of Lasers
Ruby laser Working Semiconductor laser,He-Ne laser ,Application of Laser.

Reference Books :

1. Engineering Physics By Malik and Singh
2. Optics by Ajoy Ghatak
3. Optics by Pedrotti and Pedrotti.

UNIT – IV

QUANTUM MECHANICS (6)

4.1 Failures of classical physics

Limitations of classical physics, Blackbody Radiation, Spectral Lines, Photoelectric Effect, Planck's Quantum Hypothesis, Einstein's Theory of photoelectric Effect, Compton effect, Existence of stationary states, Stern-Gerlach Experiment

4.2 DeBroglie waves & Uncertainity Principle
Introduction, Matter waves Electron Diffraction Experiment Standing waves of an electron in orbit, Uncertainity Principle Single Slit Experiment, Application of Uncertainty Principle.

4.3 Wave function, Schrodinger Equation & probablity interpretation
Time Dependent Schrodinger Equation ,1- D Equation for a free particle, extension to 2-D, Inclusion of forces, Probability current Density

4.4 Operators , expectation values & Time independent Schrodinger Equation
Operators ,Expectation Value, Ehrenfest Theorem, time independent schrodinger Equation and Admissibility Conditions on Wave function.

4.5 Solution for generalised potential
Motion of a particle in a Potential – Classical view .

4.6 Particle in a box
Square well potential with Rigid walls, Energies and Wave functions

Reference Books:

1. Modern Physics by A. Beiser
2. Quantum Mechanics by Aruldhas.

UNIT – V
CONDENSED MATTER PHYSICS (6)

5.1 CRYSTALLOGRAPHY-I
Introduction, Crystal ,Single, poly and Amorphous state, Lattice Points and Space Lattice, Unit cell, Primitive Unit Cell in 2-D ,Non-primitive Unit Cell in 2-D lattice ,Primitive unit cell in 3-D ,Non Primitive unit cell in 3-D,Bravais Lattice and crystal systems, Atomic Packing, Crystal structure

5.2 Crystallography-II
Miller Indices, Positions, Directions, Planes Obtaining Miller indices, Important Cubic crystal structures, SC, BCC, FCC, Closed Packed structures, Packing fraction, NaCl Structure, Diamond, ZnS Structure.

5.3 X-ray diffraction
Introduction, Bragg's Law, Diffraction Direction Experimental Methods of x-Ray Diffraction, Powder method Debye - Scherrer Method Measurement of Bragg Angle

5.4 Defects in crystals
Introduction, Classification of Imperfections, Point Defects, vacancies, Schottky defects, Intersitial, Frenkel defects, Impurities, Colour centres, Line defect Planar Defects, Volume

Defects, Thermodynamical consideration for Existence of Defect equilibrium concentration of Schottky defects in metals, Equilibrium concentration of schottky defects in Ionic crystals, Frenkel defect in metals, Frenkel defects in ionic crystals

5.5 Electron theory of metals

Important properties of metals, electron theory of solids, classical free elecrtron theory, DC Electrical Conductivity, Gains of Drude Model, Sommerfeld quantum Model, Fermi Energy, Density of Energy States, carrier Concentration, Drawbacks of Sommerfeld Theroy

5.6 Band theory of solids

Introduction, Formation of Energy Bands in Crystals, Characteristics, Bonding, Classification, Intrinsic and Extrinsic Semiconductors, Band structure, Energy Bands, Fermi Level and Fermi Energy, Carrier Concentration, Density of electrons in Conduction band, Position of Fermi level, Hall Effect, Applications

Reference Books:

1. Solid state Physics by Dekker
2. Solid state Physics By C.Kittel

MA1101 **MATHEMATICS - I**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **4-0-0-4**

Course Objectives:

- To give a thorough explanation of real sequences and series.
- To introduce the concepts of Euclidean space and the behavior of functions in them.
- To emphasize the applications of differentiation on real functions and their geometrical inferences.
- Introduction to Numerical analysis.
- To Introduce Fourier series and it's applications.

Course Outcomes:

At the end of the course student will be able to

- Explain concept of limit of function of two variables
- Understand the two path criterion to show that a limit does not exist and apply it to solve problems about limits
- Memorize definition of partial derivative and illustrate geometric meaning withthe aid of sketches.
- Provide geometrical meaning of second partial derivative with respect to onevariable
- Calculate directional derivatives and gradients &Apply it to solve problems involving steepest ascent and normal vectors to level curves.
- Apply the method of Lagrange Multipliers to solve such constrained optimization problems.
- Understand & apply various theorems like, Rolle's theorem.Lagrange's Mean value theorem, Cauchy Mean Value theorem in Calculus.
- Understand & Apply various tests for convergence of sequences & series
- Find the find the fourier series of periodic functions
- Find the Fourier sine and cosine series for functions defined on an interval.
- Use to numerical methods in modern scientific computing
- Find the roots of various types of equations using Numerical methods & find the area under the curve using Trapezoidal Rule, Simpson $\frac{1}{3}$ Rule, Simpson $\frac{3}{8}$ Rule

UNIT-I

Sequence: Definition of sequence, convergence, limit of a sequence, divergence, oscillation, bounded and monotonic sequences, Bounded sequences, Sandwich theorem, Algebra of limits, L'Hospital Rule in sequences, subsequences and its limit.

Series: Infinite series, partial sum, convergence, divergence, oscillation, Geometric series, Telescoping series, Algebra of Limits, n^{th}- term test, Comparison test, Comparison test (Limit Form), Integral test, D'Alembert's Ratio test, Cauchy's Root test, Alternating series, Leibnitz's Rule, Absolute convergence, Conditional convergence, Power series, Radius of convergence for a power series.

UNIT-II

Differential calculus: Rolle's theorem, Lagrange's mean value theorem, Cauchy's Mean-value theorem, Taylor's Theorem and Expansion, Maclaurin's Theorem and Expansion, Indeterminate forms and application of L'Hospital Rule. Radius of curvature, Envelope, Increasing and decreasing functions, concavity, convexity and point of inflexion, Asymptotes-Curve Tracing(Sketching)

UNIT-III

Functions of Several Variable Calculus:

Definition of continuity and differentiability in single variable, n-dimensional Euclidean space, Neighborhood of a point in n-dimensional Euclidean space, Functions in n-variables, Functions in 2 & 3 variables, Interior points, Boundary points, open and closed regions, Limit and continuity, Two-path test, Discontinuities, Partial Differentiation, Clairaut's theorem(for mixed Partial Derivatives), Laplace equation, Homogeneous functions , Euler's theorem for Homogeneous functions, Differentials and derivatives, Derivatives of composite functions, Chain Rule, Jacobians, Taylor's Theorem, Maxima and minima, Lagrange's method of multipliers.

UNIT-IV:

Fourier Series:

Definition of Fourier Series, Fourier Series representation of function, Limit of Convergence of Fourier Series, Even & Odd functions, Gibb's Phenomenon, Sine and Cosine Series, Limit of Convergence of Sine & Cosine Series. Integration and Differentiation of Fourier Series, Bessel's Inequalities, Parseval's Theorem.

UNIT-V

Numerical Methods:

Introduction: True value, Approximate Value, Error, Error percentage, Application of Numerical Analysis in various fields.

Numerical Analysis in solving Algebraic equations: Algebraic equations, Transcendental equations, Bisection Method, Regula -Falsi Method, Newton-Raphson Method.

Numerical Integration: Trapezoidal Rule, Simpson $\frac{1}{3}$ Rule, Simpson $\frac{3}{8}$ Rule

Text Books:

1. Thomas Calculus, Maurice D.Wier, Joel Hass Eleventh Edition, Pearson Education ,2008

2. R.K. Jain & S.R.K.Iyengar, Advanced Engineering Mathematics, Third Edition, Narosa publications, 2007.

3. Erwin Kreyszig, Advanced Engineering Mathematics, 8th Edition, John Wiley & Sons Ltd 2006.

Suggested References:

1. B.S. Grewal and J.S. Grewal, "Higher Engineering Mathematics",(40th Edition), Khanna Publishers,2007
2. S.S. Sastry ,Introductory Methods of Numerical Analysis ,Third Edition, Prentice Hall India

*L-T-P-C stands for number of lectures, tutorials, practices and credits

CS1101 PROGRAMMING IN C

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Prerequisites

1. No prerequisites
2. Requires analytical skills and logical reasoning.

Course Objectives

This course starts from the basics of computers and program development

- It covers various concepts of C programming language
- To learn how to write modular and readable C Programs
- To learn to write programs (using structured programming approach) in C to solve problems.
- To introduce the students to basic data structures

Course Outcomes

1.Develop C programs for computing and real life applications using basic elements like control statements, arrays, functions, pointers and strings and Implement searching and sorting algorithms

UNIT – I

Introduction to Computer Programming: Computing Environments, Computer Languages, Creating and
Running Programs. Algorithms and Flow charts : Definition of Algorithms, examples, Symbols used in
Flow chart, examples. Introduction to C Language - Background, C Identifiers, Data Types, Operators,
Variables, Constants, Input / Output, Expressions, C Programs, Precedence and Associativity, Evaluating
Expressions, Type Conversion, Statements, Bitwise Operators.

UNIT-II

Selection: Logical Data and Operators, if-else, switch Statements, Standard Functions. Repetition: loops, while, for, do-while statements, Loop examples, break, continue, go to. Arrays

- Concepts, Using Arrays in C, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays, Linear and Binary Search, Selection, Bubble, Insertion Sorts.

UNIT – III

Functions: Designing Structured Programs, Functions Basics, User Defined Functions, Inter Function Communication, Standard Functions, Scope, Storage Classes-auto, Register, Static, Extern, Scope Rules, and Type Qualifiers. Recursion- Recursive Functions, Preprocessor Commands. Strings - Concepts, C Strings, String Input / Output Functions, Arrays of Strings, String Manipulation Functions.

UNIT – IV

Pointers - Introduction, Pointers to Pointers, Compatibility, void Pointers, Arrays and Pointers, Pointer
constants, Pointers and Strings, Pointers to Functions, Point ers to Constant Objects, Constant Pointers,
Pointer Arithmetic.Call-by-reference: Pointers for Inter-Function Communication, Passing Arrays to a Function.Dynamic Memory Allocation: Memory Allocation Functions, Programming Applications,
Command-line Arguments.

UNIT – V

The Type Definition (type def), Enumerated Types Structure: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Self Referential Structures, Unions. Input and Output: Files, Streams, Standard library Input Output Functions, Character Input Output Functions.

Suggested Reading:

1. Rajaraman V, The Fundamentals of Computer, 4th Edition, Prentice Hall of India, 2006
Kernighan BW and Ritchie DM, The C Programming Language, 2nd Edition, Prentice Hall of India, 2006.
2. J.R. Hanly and E.B. Koffman, Problem Solving and Program Design in C, Pearson Education, 2007.

HS1001 English for Communication

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To complement the comprehensibility of the Technical subjects in a better way.
- To make them competent to attempt and qualify in various tests.
- To develop the study skills in formal and informal situations.

Course Outcomes:

Students will be able

* To learn the impacts of technology on language and personal life.
* To pronounce better and enhance their reference skills.
* To appreciate the aesthetic understanding and pleasure reading.
* To improve analysis skills through movies.
* To strengthen public speaking skills.
* To refine their comprehensive writing skills

UNIT-I

A Road Not Taken by Robert Frost: Understanding the Poem- Importance of the poem – Figures of Speech –Simile- Metaphor- Alliteration- Onomatopoeia - Invictus (2009)

UNIT-II

Phonetics: Commonly Mispronounced Words - Consonants - Vowels – Voiced & voiceless - BBC Phonetic Transcription – Syllabification - Word Stress - Tongue Twisters – The King's Speech (2010) – My Fair Lady (1968)

UNIT-III

What's Up? An Excerpt from The Hindu (September 29, 2015) – Binomials and Portmanteau - Common errors in English Usage

UNIT-IV

Malala's Speech: An Excerpt from www.noble.org (10 December 2014): Self-Introduction - One Word Substitutes - Homophones, Homonyms and Homographs - Debate - Group Discussion

– Girl Rising (2013)

UNIT-V
The Nightingale and the Rose by Oscar Wilde: - Skimming and Scanning - Dialogue writing: Seeking Permission, Requesting, and Interrupting – Tangled (2010)

UNIT –VI
Anand's Super 30 for IIT - JEE : An Excerpt from The India Today (July 11,15): Letter Writing - Formal Letter - Informal Letter - Notice Writing - Email writing – Freedom Writers (2007)

UNIT –VII
Education and Technology - Burj Khalifa : www.natgeotv.com : Burj Khalifa (Documentary Video)- JAM/PPT Presentations - Essay Writing

UNIT –VIII

A Missile Man – Dr. APJ Kalam: An Excerpt from The Hindu (Sept 25, 2006) – Interviews - Curriculum Vitae or Resume preparation – I am Kalam (2010)
FURTHER STUDIES (SELF STUDY): U-I: Capitalization, Punctuation (commas, full stop, inverted marks) - U-II: Words often Confused, Affixes (Prefixes and Suffixes), Commonly Mispronounced Words, Tongue Twisters - U-III: Articles - Prepositions, Spotting the Error –

UIV: Index –Grammar (Additional Information)
Tenses – U-V: Active and Passive, Direct and Indirect Speech – U-VI: Understanding the rules of spelling Part1&2 – U-VII: Commonly Used Phrasal Verbs & Idioms – U-VIII: Antonyms and synonyms

Suggested References:

1. Meenakshi Raman, Sangeetha Sharma. "***Effective Technical Communication***." Oxford: Oxford University, New Delhi, 2015.
2. Murali Krishna, ***"English for Engineers."*** Pearson Education, Inc. New Delhi, 2015.
3. 3. E. Suresh Kumar, P. Sreehari and J. Savithi**.** ***"English for Success."*** Foundation Books, Inc. New Delhi, 2014.
4. 4. Ashraf. M. Rizvi, ***"Effective Technical Communication."*** Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2015.
5. 5. Hari Mohan Prasad and Rajnish Mohan, ***"How to prepare for Group for Group Discussion and***

Interview." 2nd Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2015.

6. 6. R.P Bhatnagar and Bhargava Rajal, ***"English for Competitive Examinations".*** McMillan India limited, 1989.
7. 7. Upendran. S, ***"Foundation Course in Spoken English Part I".*** McMillan India limited, 1989.
8. 8. Upendran. S, ***"Foundation Course in Spoken English Part II".*** McMillan India limited,1989.

Web sources:

1. www.usingenglish.com
2. www.talkenglish.com
3. www.oxforduniversity.com
4. www.wikipedia.com
5. www.about.com

For Literature:

1. www.cliffsnotes.com
2. www.sparksnotes.com
3. www.gradesaver.com

www.nofearshakespeare.com

HS1101 Communication Skills- I

Externals: 60 Marks **L-T-P-C***
Internals: 40 Marks **2-0-0-1**

Course Objectives:

1. To make the students efficient communicators via experiential learning.

2. To enhance learners' analytical and creative skills, so that they will be capable to address a wide variety of challenges in their professional lives.

3. To help learners to improve the leadership qualities and professional etiquette

4. To expose learners to an effective communicative environments.

Course Outcomes:

Students will be able to:

1. Develop interpersonal communication, small group interactions and public speaking.

2. Exercise the writing assignments, precise writing for informational, persuasive and creative purposes.

3. Apply right form of structural usage of sentences in their written and oral communication.

4. Develop confidence and skills related reading comprehension.

5. Improve a logical framework for the critical analysis of spoken, written, visual and mediated messages upon a diverse platforms.

6. demonstrate the ability to apply vocabulary in practical situations.

Unit I – Introduction to communication

Introduction – Importance of Communication Skills – Definition – Scope and Nature – Verbal and Nonverbal communication

Unit II – Reading Skills

Reading Comprehension of unseen passage – Prose – News Paper Reading and Analysis (Editorial)

Unit III - Grammar

1. Parts of Speech
2. Subject and predicate
3. Articles – Determiners
4. Conjunctions (Linkers; connectors; cohesive devices)
5. Verbs – Transitive and Intransitive - Finite and Infinite - Regular and Irregular - Modals
6. Tenses
7. Prepositions/ Prepositional verbs
8. Adverbs – types and their order in sentences
9. Adjectives
10. Including Degrees of Comparison and also Quantifiers

Unit IV – Enhancing Vocabulary

Developing Professional vocabulary – Using Dictionary: Spelling – Grammar and Usage

Unit V - Composition

Paragraph – Essay - Expansion - Describing the Pictures – Giving Directions – Situational Dialogue writing – Social and Professional Etiquette – Telephone Etiquette

Suggested References:

1. Joseph Mylal Biswas book of English Grammar

2. R. Murphy -Cambridge Press

3. Wren and Martin

4. The Good Grammar book by OUP

5. Communication skills by M. Raman and Sangeeta Sharma

6. How to Win Friends and Influence people by Dale Carnigie

7. How to Read and Write Better by Norman Lewis

8. Better English by Norman Lewis

9. Use of English Collocations by OUP

10. www.humptiesgrammar.com

11.www.bbcenglisgh.com

12.www.gingersoftware.com

13. www.pintest.com

EC1701 Network Analysis Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

Course Objectives

1. To make the students capable of analyzing any given electrical network.
2. To make the students learn how to synthesize an electrical network from a given impedance/admittance function.

Course Outcomes

1. Students will be able to analyze the various electrical and electronic networks using the techniques they learn.
2. Students will be able to construct a circuit to suit the need.

LIST OF EXPERIMENTS:

1. Study of amplifier using transistor and analysis of harmonic distortion of it.
2. Making of inductor with and without ferrite core and study of its behavior.
3. Study of circuit under Eigen excitation incase of symmetrical and non symmetrical networks.
4. Study of transfer characteristic of circuits containing diodes to find cut-in voltage.
5. Study of relative amplitude of first and second harmonics of half wave rectified output of diode.
6. Maximum Power Transfer Theorem
7. Transient and frequency response of RLC series circuit
8. Measurement of Z, Y, and ABCD parameters of a two port network.

PH 1601 ENGINEERING PHYSICS LAB

Externals: 60Marks **L-T-P-C***

Internals: 40Marks **0-0-3-2**

Course Objectives:

* To sensitize students to their communication skills.
* To make the students practice the language skills (L, S, R, W).

Course Outcomes:

1. Students will be able to write essays and paragraphs that demonstrate proper usage of grammar.
2. Students will demonstrate the ability to critique their grammar assignments.
3. Students will be able to assess their pronunciation of words.
4. Students will analyze the forms of different expressions in English Language that reflect the individual, social, and cultural values.
5. Students will demonstrate the proficiency in oral and written communication.

UNIT-I –

Grammar – Adjectives – Comparatives and Superlatives – Adverbs – Countable and Uncountable Nouns – Pronouns – Simple present – Present continuous – Simple past- Conjunctions – Prepositions – Plurals – Articles a, an, the – Infinitive or –ing – Questions and Negatives -1 - Questions and Negatives -2

UNIT-II

Pronunciation – Pill/Fill – Buy/My – Tie/Die – Ship/Chip – Yet/ Jet – Game/ Came – Wail/Veil – Think/Sink – There/Dare – Price/ Prize – Asia/ Hard – Ran/Rang – Right/Light – Ship/Sheep – Head/Had- Schwa – Luck/ Look - Hat/Heart – But/Boot – Who/ Her – Pot/Port – Hair/ Hear – Pay/Pie – Boy/Buy – Know/ Now

UNIT-III

Writing – Writing a Thank You Letter – Writing about your life – Writing Instructions – Writing a Story – Writing an Essay – Writing a Business Letter – Writing a Film Review – Writing a Biography – Writing a Complaint Letter – Writing a Covering Letter - Writing a Pen friend Post - Writing about a Special Day - Writing an E-mail of Apology - Writing a Short Report - Writing a Post Card

UNIT – IV

Reading - The diamond thief – The guru and sweets – Taking a course – Reading a story - Using a dictionary – Making a journey – Reading a newspaper – Making friends – Reading an email – Finding information – A pen friend letter – The doctor says…- Choosing a holiday – Struck by lightning – Health matters :Yoga

UNIT – V

Listening – What shall we play? – An exciting weekend – A school outing – The morning assembly – Instructions on planting – Excuse me, can you lend me…- Manish's summer – Vignesh's hobby – What can I do for you? – What are you doing Ramesh? – I've got a few questions…- Geetha's day – Anil's new purchase – What are we having tonight? – What is the problem?

Suggested References:

1. Clarity English Success - Software
2. http://www.clarityenglish.com/program/practicalwriting/
3. http://www.clarityenglish.com/program/roadtoielts/
4. http://www.clarityenglish.com/program/clearpronunciation1/

http://www.clarityenglish.com/program/resultsmanager/

CS1701 Programming in C Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

Course Objectives:

1. Able to have fundamental concept on basics commands in Linux.

2. Able to write, compile and debug programs in C language.

3. Able to formulate problems and implement algorithms in C.

4. Able to effectively choose programming components that efficiently solve computing problems in real-world

Experiments:

Suggested assignments to be conducted on a 3-hour slot. It will be conducted in tandem with the theory course so that the topics for problems given in the lab are already initiated in the theory class. The topics taught in the theory course should be appropriately sequenced for synchronization with the laboratory. A sample sequence of topics and lab classes for the topic are given below:

1. Familiarization of a computer and the environment and execution of sample programs
2. Expression evaluation
3. Conditionals and branching
4. Iteration
5. Functions
6. Recursion
7. Arrays
8. Structures
9. Files

For the detailed list of programs refer the lab manual.

Note: Any experiment according to the syllabus of CS1101 can be substituted

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Rajiv Gandhi University of Knowledge Technologies

Basar, Nirmal – 504107

B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

I YEAR II SEMISTER

Subject Code	Subject Name	L-T	P	C
EE1201	Electrical technology	4	-	4
CY1001	Chemistry	4	-	4
MA1201	Mathematics-II	4	-	4
CS1201	Scripting languages	4	-	4
HS1201	Communication Skills-II	2	-	1
CE1601	Engineering drawing	4	-	4
EE1801	Electrical technology Lab	-	3	2
HS1601	English Lab	-	2	2
CY1601	Chemistry Lab	-	3	2
	TOTAL	**22**	**8**	**27**

EE1201 Electrical Technology

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. To acquire the basic concepts of AC and DC Machines
2. To learn the basics of Alternators, Transformers.
3. To learn the measurement characteristics of Voltmeter, Ammeter, Wattmeter and Energy meter.

UNIT- I: THREE PHASE AC CIRCUITS

Three phase EMF generation, delta and Y connections, line and phase quantities, solution of three phase circuits, balanced supply voltage and balanced load, phasor diagram, measurement of power in three phase circuits, Three phase four wire circuits.

UNIT -II: TRANSFORMERS

Magnetic Circuits :

Ampere's circuital law, B- H curve, solution of magnetic circuits, hysteresis and eddy current losses, relays, an application of magnetic force, basic principles of stepper motor.

Transformers :

Construction, EMF equation, ratings, phasor diagram on no load and full load, equivalent circuit, regulation and efficiency calculations, open and short circuit tests, auto-transformers.

UNIT -III: INDUCTION MOTORS

The revolving magnetic field, principle of orientation, ratings, equivalent circuit, Torque-speed characteristics, starters for cage and wound rotor type induction motors.

UNIT -IV: DC MACHINES

Construction, EMF and Torque equations, Characteristics of DC generators and motors, speed control of DC motors and DC motor starters.

UNIT- V: ELECTRICAL MEASURING INSTRUMENTS

DC PMMC instruments, shunt and multipliers, multimeters, Moving iron ammeters and voltmeters, dynamometer, wattmeter, AC watthour meter, extension of instrument ranges.

TEXT BOOKS:

1. Electric machinery - A.E. Fitzgerald, C.Kingsley and S.Umans, Mc Graw Hill Companies, 5th edition

2. Electrical machines-PS Bhimbra, Khanna Publishers.

3. Electromechanics – II , by Kamakshaiah

REFERENCE BOOKS:

1. Performance and Design of AC Machines by MG.Say, BPB Publishers

2. Theory of Alternating Current Machinery- by Langsdorf, Tata McGraw-Hill Companies, 2nd edition.
3. Electric Machines –by I.J.Nagrath & D.P.Kothari,Tata Mc Graw Hill, 7th Edition.2005
4. Fundamentals of Electric Machines by B. R. Gupta, Vandana singhal, 3rd Edition, New age international Publishers
5. Electrical Measurements and measuring Instruments – by E.W. Golding and F.C. Widdis, 5th Edition, Reem Publications.
6. Electrical & Electronic Measurement & Instruments by A.K.Sawhney Dhanpat Rai & Co. Publications.

CY1001 ENGINEERING CHEMISTRY

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **4-0-0-4**

Course Objectives:

1. To understand the basic concepts of phase rule and catalysis with examples
2. To understand the importance of the spectroscopy in determining the structures of chemical compounds
3. To understand the importance of electrochemistry in technical filed
4. To understand the corrosion and types of corrosion
5. To understand the rates of some of the reactions and derivation of their rate laws
6. To understand the basic concepts of polymers, lubricants, and nanomaterials

Course Outcomes:

1. Will be able to understand the structural elucidation of organic compounds using spectroscopy.
2. Will gain knowledge on basic electrochemical reactions, corrosion and prevention of corrosion.
3. Will gain knowledge on rate law, kinetic reactivity of complex reactions and phase rule.
4. Will gain necessary knowledge in catalysis.
5. Will understand the basic concepts of polymers, lubricants, and nanomaterials, essential for engineering graduates

Unit 1: Phase Rule & Catalysis (7 classes)

Phase Rule: Terminology, One component system (H_2O system and CO_2 – system), two components system, Simple eutectic system (Pb – Ag), system with congruent melting point (Zn – Mg), system with incongruent melting point (Na_2SO_4 –H_2O), Cooling curves.

Catalysis : Mechanism of catalytic reactions: catalyst definition, characteristics and types of catalysis, theories of catalysis, intermediate compound formation theory with examples and mechanism, drawbacks of intermediate compound formation theory, adsorption or contact theory with examples and mechanisms, enzyme catalysis, characteristics and mechanism of enzyme catalysis, concepts of promotors, inhibitors, and poisioners.

Unit 2: Spectroscopy (7 classes)

Introduction to spectroscopy, electromagnetic radiations, different types of spectroscopy, principle of spectroscopy, spectrophotometer Microwave spectroscopy: principle, microwave spectra of diatomic molecules, selection rules for microwave spectra, applications of microwave spectroscopy: determination of bond length, dipole moment measurement, determination of isotopic mass of an element. Infrared spectroscopy: introduction and principles of IR, types of vibrations: bending and stretching, Hooke's law for stretching vibrations, characteristic frequencies of common functional groups, IR instrumentation, interpretation and applications of IR spectrum with examples. Ultra-violet spectroscopy: Introduction and principle of UV spectroscopy, color interpretation with VBT and MOT, types of electronic transitions, selection rules, chromophores and auxochromes with examples, conjugation effect, absorption and intensity shifts, applications of UV spectroscopy.

Unit 3: Electrochemistry (8 classes)

Types of electrodes: introduction, metal-metal ion electrodes, metal-insoluble salt-anion electrodes, calomel electrode, gas-ion electrodes, hydrogen and chlorine electrodes, oxidation-reduction electrodes, amalgam electrodes. Types of cells: classification into chemical and concentration cells, chemical cells with transference and without transference, classification of concentration cells into electrolyte and electrode concentration cells, electrolyte concentration cells with and without transference, amalgam and gas concentration cells, examples for these cells. EMF and applications of EMF: determination of pH, determination of the valency of the ions, potentiometric titrations. pH: definition of pH and determination of pH by various methods, acid-base titrations. Thermodynamic data: enthalpy and entropy of cell reactions, Gibbs-Helmholtz equation and applications.

Unit 4: Corrosion and its prevention (4 classes)

Mechanism of Dry and wet corrosion (rusting of iron), Types of corrosion, galvanic corrosion, differential aeration corrosion, stress corrosion. Factors affecting corrosion, preventive measures (proper design, Cathodic and Anodic protection, Electroplating , tinning, galvanization).

Unit 5: Chemical kinetics (6 classes)

Complex reactions: definition and classification of complex reactions, definition of reversible reactions with examples, rate law derivation for reversible reactions. Consecutive reactions: definition, rate law derivation and examples of consecutive reactions. Parallel reactions: definition, rate law derivation and examples of parallel reactions. Steady-state approximation: introduction, kinetic rate law derivation by applying steady state approximation in case of the oxidation of NO and pyrolysis of methane. Chain reactions: introduction, types and mechanism of chain reactions, stationary and non-stationary chain reactions with examples, deriving the kinetic rate equation using a general chain reaction. Photochemical reactions: introduction, Stark-Einstein law of photochemical equivalence, photophysical processes: IC, ISC, fluorescence and phosphorescence with examples, kinetic rate law derivation incase of photochemical decomposition of HI and photochemical combination of H_2 and Br_2.

Unit 6: Engineering Materials (8 classes)

Polymers: Types of polymerization (chain & step growth). Plastics: Thermoplastic & Thermo setting resins; preparation, properties, engineering applications of PVC, Teflon and Bakelite. Conducting polymers: polyacetylene, polyaniline, mechanism of conduction, doping; applications of conducting polymers.

Cement: composition of portland cement, setting & hardening of cement (reactions). **Lubricants**: Classification with examples-Characteristics of a good lubricant & mechanism of lubrication (thick film, thin film and extreme pressure) –properties of lubricants: viscosity, cloud point, flash and fire points.

Refractories: Classification, characteristics of a good refractory and applications. **Nanomaterials:** Introduction, preparation by sol-gel & chemical vapour deposition methods, applications of nanomaterials.

Reference Books

1. Chemistry for Engineers, B. K. Ambasta
2. Engineering Chemistry, H. C. Srivastava
3. Applied Chemistry – A textbook for engineers and technologist by H.D. Gesser
4. Engineering Chemistry: by P C Jain & Monika Jain
5. A Text Book of Engineering Chemistry: by Shashi Chawla
6. Fundamental of Organic Spectroscopy by Y. R. Sharma
7. Introduction to spectroscopy by Pavia, Lampman, Kriz

MA1201 **Mathematics - II**

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

- To learn the concepts of Eigen values, Eigen vectors, vector spaces and its basis.
- Toprovideanoverviewofordinary differentialequations
- To study the methods of solving improper integrals and the concepts of multiple integrals
- To studyvectordifferentialandintegralcalculus

Course Outcomes:

At the end of the course student will be able to

- Understand the definitions of Vector Spaces, Basis and Dimension of Vector Space.
- Understand the concept Linear Transforms and related theorems.
- Find the Eigen values & Eigen vectors of a given Matrix
- Apply Cayley Hamilton theorem for problems in Matrices
- Identify an ordinary differential equation and its order
- Classify ordinary differential equations into linear and nonlinear equations
- Model radioactive decay, compound interest, and mixing problems using first order equations
- Solve first order linear differential equations and special non linear first order equations like Bernouli , Riccati &Clairaut's equations
- Find the general solution of second order linear homogeneous equations with constant coefficients
- Use the method of undetermined coefficients to solve second order, linear homogeneous equations with constant coefficients
- Use the method of variation of parameters to find particular solutions of second order, linear homogeneous equations
- Compute double integrals over rectangles and \type I and II" regions in the plane
- Compute double integrals over a sector of an annulus using polar coordinates
- Memorize the statement of the change of variables theorem for double integrals, illustrate its geometric meaning with the aid of sketches, and apply it to computeintegrals over regions that are neither type I nor type II.
- Explain the concept of a vector field andmake sketches of simple vector fields inthe plane.
- Memorize statement and understand proof of Fundamental Theorem of Calculusfor functions on curves.
- Explain concept of a conservative vector field, state and apply theorems that give necessary and sufficient conditions for when a vector field is conservative, and describe applications to physics

- Memorize Green's Theorem, and make sketch illustrating it. Explain how Green's Theorem is a generalization of the Fundamental Theorem of Calculus.
- Recognize the statements of Stokes' Theorem and the Divergence Theorem and understand how they are generalizations of the Fundamental Theorem of Calculus.Be aware of applications of these theorems in Physics and Mechanical Engineering.

UNIT-I

Linear Algebra: System of Linear equations ,Vector spaces, Subspaces, Linear combination of vectors, linear dependence and independence of vectors, Basis and Dimension of Vector Space.

Linear transformations, Range and Kernel of Linear Transformations, Rank-Nullity theorem. Matrix representations of Linear Transformation.Eigenvalues and Eigenvectors of a Linear Transformation and their properties , Cayley - Hamilton Theorem, Hermitian and skew Hermitian matrices. Quadratic forms, reduction of quadratic form to canonical form by orthogonal transformation.

UNIT-II

Ordinary Differential Equations of first order: Exact first order differential equation, finding integrating factors, linear differential equations, Bernoulli's , Riccati , Clairaut's differential equations, finding orthogonal trajectory of family of curves, Newton's Law of Cooling, Law of Natural growth or decay.

UNIT-III

Ordinary Differential Equations of higher order: Linear dependence and independence of functions, Wronskian of n- functions to determine Linear Independence and dependence of functions, Solutions of Second and higher order differential equations (homogeneous & non-homogeneous) with constant coefficients, Method of variation of parameters, Euler-Cauchy equation.

UNIT-IV

Integral Calculus : Convergence of improper integrals, tests of convergence, Beta and Gamma functions - elementary properties, differentiation under integral sign, differentiation of integrals with variable limits - Leibnitz rule. Rectification, double and triple integrals, computations of surface and volumes, change of variables in double integrals - Jacobians of transformations, integrals dependent on parameters – applications.

UNIT-V

Vector Calculus : Scalar and vector fields, level surfaces, directional derivative, Gradient, Curl, Divergence, Laplacian, line and surface integrals, theorems of Green, Gauss and Stokes.

Text Books:

1.Advanced Engineering Mathematics (3rd Edition) by R. K. Jain and S. R. K. Iyengar, Narosa Publishing House, New Delhi

Suggested References:

1. Advanced Engineering Mathematics (8th Edition) by Erwin Kreyszig, Wiley-India.

2. Dr. M.D. Raisinghania, Ordinary and Partial differential equations, S.CHAND, 17^{th} Edition 2014.

*L-T-P-C stands for number of lectures, tutorials, practices and credits

CS1201 Scripting Languages

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Prerequisites

1. Programming in C and Data Structures.

Course Objectives

1. To learn scripting languages- Python, Perl, PHP

Course Outcomes;

1. Student will be able to write dynamic web pages and will also be able to build a basic search engine using python and also search through text files using Perl.

UNIT-I

Python - Introduction-Variables, Strings, numbers, comments, Lists- introducing list, lists and looping, common list operations, removing items from list, numerical lists, list comprehensions, strings as lists, tuples, file I/O, functions, conditional statements and iterative statements.

UNIT –II

Python - Dictionaries, common operations with dictionaries, looping through dictionaries, nesting, classes, inheritance, modules and classes, exceptions and testing. Exceptions, sorting, introduction to standard libraries, building a Search Engine using all the above concepts.

UNIT-III

Perl – Data types, scalar functions, Quoting Basics, Functions, Control Structures, Inputs, Error Handling.

UNIT-IV

Perl – File input output, text processing functions, Hashes, DBM Databases, Regular Expressions.

UNIT- V

HTML – Styles, links, images, Static and Dynamic pages, Paragraphs and Fonts, Lists, CSS introduction, Introduction to HTML5 and semantics. PHP – Loops, String Functions, Email function, Data and time, Image Uploading, Error Handling.

Text Books:-

2. Programming Python, 4th Edition Powerful Object-Oriented Programming By Mark Lutz
3. Learning Perl, Randal L Schwartz.
4. Web Programming, building internet applications, Chris Bates 2nd edition, WILEY Dreamtech

HS1201 Communication Skills- II

Externals:	**60Marks**	**L-T-P-C***
Internals:	**40Marks**	**2-0-0-1**

Course Objectives:

- To develop the learners ability to read fluently and critically.
- To make awareness of the common punctuation marks and the importance of it in writing
- To build academic vocabulary of the learners
- To offer the learners opportunity to practice creative writing
- To make the learners apply the skills and strategies of a successful listener

Course Outcomes:

The learners will be able to:

- make use of contextual clues to infer meanings of unfamiliar words from context and make inferences and predictions based on comprehension of a text
- punctuate simple sentences correctly
- produce appropriate vocabulary and correct word forms;
- Write creatively and accurately. They will also have a critical awareness of their writing in terms of unity, content, coherence and linguistic accuracy (grammatical structure and choice of vocabulary).
- Comprehend the talks and presentations, take organized notes on lectures and listening passages

Unit I - Reading

Reading Skills – Importance - Definition –Types -Techniques and strategies

Unit II – Punctuation and Capitalization

Punctuation - Use of Capital Letters

Unit III – Vocabulary

1. Antonyms
2. Synonyms
3. Affixation
4. Vocabulary in context
5. Proverbs /Collocations
6. One word substitutes
7. Idioms and Phrasal verbs

Unit IV – Writing Skills

Creative writing – Story Writing – Precise - Letter writing

Unit V - Listening

Listening Skills – Academic Listening – Listening to Talks and Presentations – Note Taking

References:

1. Meenakshi Raman and Sangeeta Sharma ***"Communication skills"*** Oxford University press, 2013
2. Wren and Martin, NDV Prasad Rao. *"**High School English Grammar and Composition**"* S. Chand& Compay Ltd, 2012
3. Michael Swan, ***"Practical English Usage"*** 3rd edition: guide to problems in English, Oxford University press, 2011
4. Edgar Thorpe and Showick Thorpe, ***"Objective English"*** 3rd Edition, Pearson, 2010

CE1601 ENGINEERING DRAWING

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **4-0-0-4**

Course Objectives:

- To understand the basic concepts of drawing and use of drafter.
- To draw the basic geometrical constructions and curves used in engineering.
- To understand and draw the projections of points, lines, planes and solids.
- To know about isometric projections.

Course outcomes:

- **Ability to draw the 3 dimensional structure by using isometric and perspective views**
- **Ability to draw the section elevation of a structure**

Concepts and conventions: Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning

UNIT-1
Plane curves and free hand sketching: Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales. Visualization concepts and Free Hand sketching: Visualization principles – Representation of three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT-II
Projection of points, lines and plane surfaces: Orthographic projection- principles- Principal planes- First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces - Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method

UNIT-III
Projection of solids: Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT-IV

Projection of sectioned solids and development of surfaces: Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V

Isometric and perspective projections: Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Computer aided drafting (demonstration only)

Introduction to drafting packages and demonstration of their use.

Suggested Readings:

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50 Edition, 2010.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age publications
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern EconomyEdition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age

EE1801 Electrical Technology Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

List of Experiments:

1. Characteristics of Fluorescent and Incandescent Lamp
2. Verification of Network Theorems
3. R-L-C Series Circuit
4. Three phase power measurement by two Wattmeter method
5. Single Phase Energy Meter
6. OC and SC Test of Single Phase Transformer
7. OCC of separately excited DC Shunt Generator
8. Load test of Three Phase Induction Motor

HS1601 English For Communication Lab

Externals: 60 Marks **L-T-P-C***
Internals: 40 Marks **0-0-3-2**

Course Objectives:

- To sensitize students to their communication skills.
- To make the students practice the language skills (L, S, R, W).

Course Outcomes:

- Students will be able to write essays and paragraphs that demonstrate proper usage of grammar.
- Students will demonstrate the ability to critique their grammar assignments.
- Students will be able to assess their pronunciation of words.
- Students will analyze the forms of different expressions in English Language that reflect the individual, social, and cultural values.
- Students will demonstrate the proficiency in oral and written communication.

UNIT-I –

Grammar – Adjectives – Comparatives and Superlatives – Adverbs – Countable and Uncountable Nouns – Pronouns – Simple present – Present continuous – Simple past-Conjunctions – Prepositions – Plurals – Articles a, an, the – Infinitive or –ing – Questions and Negatives -1 - Questions and Negatives -2

UNIT-II

Pronunciation – Pill/Fill – Buy/My – Tie/Die – Ship/Chip – Yet/ Jet – Game/ Came – Wail/Veil – Think/Sink – There/Dare – Price/ Prize – Asia/ Hard – Ran/Rang – Right/Light – Ship/Sheep – Head/Had- Schwa – Luck/ Look - Hat/Heart – But/Boot – Who/ Her – Pot/Port – Hair/ Hear – Pay/Pie – Boy/Buy – Know/ Now

UNIT-III

Writing – Writing a Thank You Letter – Writing about your life – Writing Instructions – Writing a Story – Writing an Essay – Writing a Business Letter – Writing a Film Review – Writing a Biography – Writing a Complaint Letter – Writing a Covering Letter - Writing a Pen friend Post - Writing about a Special Day - Writing an E-mail of Apology - Writing a Short Report - Writing a Post Card

UNIT – IV

Reading - The diamond thief – The guru and sweets – Taking a course – Reading a story - Using a dictionary – Making a journey – Reading a newspaper – Making friends – Reading an email – Finding information – A pen friend letter – The doctor says…- Choosing a holiday – Struck by lightning – Health matters :Yoga

UNIT – V

Listening – What shall we play? – An exciting weekend – A school outing – The morning assembly – Instructions on planting – Excuse me, can you lend me…- Manish's summer – Vignesh's hobby – What can I do for you? – What are you doing Ramesh? – I've got a few questions…- Geetha's day – Anil's new purchase – What are we having tonight? – What is the problem?

Suggested References:

5. Clarity English Success - Software
6. http://www.clarityenglish.com/program/practicalwriting/
7. http://www.clarityenglish.com/program/roadtoielts/
8. http://www.clarityenglish.com/program/clearpronunciation1/
9. http://www.clarityenglish.com/program/resultsmanager/

CY1601 **ENGINEERING CHEMISTRY LABORATORY**

Externals: 60 Marks **L-T-P-C**

Internals: 40 Marks **0-0-3-2**
Course Objectives:

1. To learn the preparation of organic compounds in the laboratory
2. To estimate the hardness and alkalinity of the given sample of water
3. To understand the Job's method for determining the composition
4. Learns how to use the pH meter and polarimeter

Course Outcomes:

Minimum knowledge on basic synthesis, quantitative and qualitative analysis is being imp

1. **Synthesis**
   i. Synthesis of soap from cheap oil.
   ii. Synthesis of Thiokol rubber

2. **Volumetric analysis**
   i. Estimation of alkalinity of water
   ii. Estimation of total hardness of water by EDTA method

3. **Job's method**
   i. Determination of composition of Ferric-Thiocyanate complex by Job's method

4. **pH meter**
   i. Estimation of the strength of a weak acid by pH metry

5. **Polarimeter**
   i. Determination of specific rotation of sucrose by polarimeter

Reference books:

1. College Practical Chemistry by V K Ahluwalia, Sunita Dhingra, Adarsh Gulati
2. Practical Engineering Chemistry by K Mukkanti
3. A Text Book of Engineering Chemistry: by Shashi Chawla
4. Essentials of Experimental Engineering Chemistry by Shashi Chawla
5. Comprehensive Practical Organic Chemistry – Preparation and Quantitative analysis byV K Ahluwalia, Renu Aggarwal

EC1201 Basic Electronics

Externals: 60Marks **(For CSE-E1S2)** **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. To introduce the fundamental concepts of semiconductor devices.
2. To understand the operation of different types of electronic devices and their corresponding applications.
3. Introduce the analysis techniques of the electronic circuits to enable the students to design simple circuits.
4. To understand the different types of operations for OP-AMP.
5. To introduce the fundamental concepts of Digital electronics.

Course Outcomes:

1. Understand the basics of PN junction diodes, transistors and their applications.
2. Understand BJT and Design and analyze BJT amplifiers.
3. Understand MOSFET and its application.
4. Learn how to bias the transistors for their application as amplifiers.
5. Ability to design simple electronic circuits to meet a practical requirement.

Unit-I: Introduction to Electronics

Introduction to Electronics and Electronic systems, Theory of Semiconductors, pn Junction Diode, Rectifiers: Half Wave Rectifier, Full Wave Rectifier, LEDs, Photo Diodes, Silicon Controlled Rectifier.

Unit-2:Transistors

Bipolar Junction Transistor, Transistor in CB and CE Configurations, Junction Field Effect Transistor, JFET Characteristics, MOSFET, Biasing of Transistors, Biasing of JFET.

Unit-3:Amplifiers and Transister models

Introduction to Amplifiers, Transistor Re Model, Transistor h parameter model, BJT Small Signal Analysis, JFET Signal Analysis, feedback Amplifiers, Phase Shift Oscillators, Wein Bridge Oscillators

Unit-4:Operational Amplifiers

Differential Amplifiers, operational amplifiers, applications of operational amplifiers:, Constant-Gain Multiplier , Voltage Summing , Voltage Buffer , Controller Sources, Instrumentation Circuits ,Active Filters .

Unit-5:Digital Electronics:

Logic gates, realization of logic gates, flip-flops, registers and counters.

TEXT BOOKS:

1. Electronic Devices and Circuit Theory – Robert L.Boylestad, Louis Nashelsky, 9th edition, 2008 PE
2. Electronic Devices and Circuits- David A. Bell- 5th Edition, Oxford University Press.

REFERENCE BOOKS:

1. Electronic Circuits Analysis and Design – Donald A Neamen, Third Edition, Tata McGraw-Hill, 2007.
2. Introductory Electronic Devices and Circuits- Robert T. Paynter, 7th edition, 2009, PEI.
3. Microelectric circuits- sedra/ Smith- 5th edition, 2009, Oxford University Press.

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B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

II YEAR I SEMISTER

Code	Subject	L-T	P	C
EC2101	Electronic Circuits	4	-	4
EC2102	Semiconductor Devices	4	-	4
EC2103	Signals and Systems	4	-	4
EC2104	Electromagnetic theory	4	-	4
BSBE 2001/3001	Environmental science	4	-	3
HS2101	Soft Skills-I	2	-	1
EC2701	Electronic Circuits Lab	-	3	2
EC2702	Semiconductor Devices Lab	-	3	2
EC2901	Seminar-1	1	-	1
	Total	**23**	**6**	**25**

EC2101 Electronic Circuits

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

- To introduce the fundamental concepts of semiconductor devices.
- To understand the operation of different types of electronic devices and their corresponding applications.
- Introduce the analysis techniques of the electronic circuits to enable the students to design simple circuits.

- To understand the different types of operations for OP-AMP.
- To introduce the fundamental concepts of Digital electronics.

Course Outcomes:

- Understand the basics of PN junction diodes, transistors and their applications.
- Understand BJT and Design and analyze BJT amplifiers.
- Understand MOSFET and its application.
- Learn how to bias the transistors for their application as amplifiers.
- Ability to design simple electronic circuits to meet a practical requirement.

Unit-I: Introduction to Electronics

Introduction to Electronics and Electronic systems, Theory of Semiconductors, pn Junction Diode, Rectifiers: Half Wave Rectifier, Full Wave Rectifier, LEDs, Photo Diodes, Silicon Controlled Rectifier.

Unit-2:Transistors

Bipolar Junction Transistor, Transistor in CB and CE Configurations, Junction Field Effect Transistor, JFET Characteristics, MOSFET, Biasing of Transistors, Biasing of JFET.

Unit-3:Amplifiers and Transister models

Introduction to Amplifiers, Transistor Re Model, Transistor h parameter model, BJT Small Signal Analysis, JFET Signal Analysis, feedback Amplifiers, Phase Shift Oscillators, Wein Bridge Oscillators

Unit-4:Operational Amplifiers

Differential Amplifiers, operational amplifiers, applications of operational amplifiers:, Constant-Gain Multiplier , Voltage Summing , Voltage Buffer , Controller Sources, Instrumentation Circuits ,Active Filters .

Unit-5:Digital Electronics:

Logic gates, realization of logic gates, flip-flops, registers and counters.

TEXT BOOKS:

1. Electronic Devices and Circuit Theory – Robert L.Boylestad, Louis Nashelsky, 9th edition, 2008 PE
2. Electronic Devices and Circuits- David A. Bell- 5th Edition, Oxford University Press.

REFERENCE BOOKS:

1. Electronic Circuits Analysis and Design – Donald A Neamen, Third Edition, Tata McGraw-Hill, 2007.
2. Introductory Electronic Devices and Circuits- Robert T. Paynter, 7th edition, 2009, PEI.
3. Microelectric circuits- sedra/ Smith- 5th edition, 2009, Oxford University Press.

EC2102 Semiconductor Devices

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

- To introduce the fundamental concepts of semiconductor materials and its characteristics.
- Identify the whether the semiconductor material is p-type or n-type by using Hall Effect.
- To understand the basic structure of p-n junction diode and Tunnel diode it's working principles.
- To understand the applications of Bipolar Junction Transistor and Unipolar Junction Transistor and its different modes of operation.

- To understand the basics of optical electronics like Photo detectors, Photoluminescence, Electroluminescence, Led and laser.

Course Outcomes:

- Students will be good at fundamental concepts of semiconductor materials and its characteristics.
- Students will be ability to identify the whether the semiconductor material is p-type or n-type by using Hall Effect.
- Students will be good at the basic structure of p-n junction diode and Tunnel diode it's working principles.
- Students will know the applications of Bipolar Junction Transistor and Unipolar Junction Transistor and its different modes of operation.
- Students will be good at the basics of optical electronics like Photo detectors, Photoluminescence, Electroluminescence, Led and laser.

UNIT -I: Introduction:

Evolution of semiconductor technology, Types of semiconductors (intrinsic & Extrinsic), mass action law, Concept of fermilevel, carrier transport phenomena: Carrier drift, Carrier diffusion, Einstein relation, hall effect.

UNIT -II:Diodes:

Basic structure of pn-junction, operation of pn-diode, non uniformly doped pn-junctions, small signal model of pn-junction, Generation-Recombination currents, Junction breakdowns, diode transients, Tunnel diode, Impatt diode.

UNIT -III:BJT:

Basic BJT action: Principle of operation, modes of operation, Amplification with BJT. Non ideal effects of BJT: Base width modulation, Emitter band gap narrowing, non uniform base doping, breakdown voltage.

UNIT -IV: MOSFET:

C-V characteristics of MOSFET, The MOSFET operation: MOSFET structure, current-voltage relationship (Mathematical), substrate bias effects, small signal equivalent model, short channel & narrow channel effects, Radiation and hot electron effect.

UNIT -V:Optical devices:

Photo detectors, Photoluminescence ,Electroluminescence ,Led and laser

TEXT BOOKS:

1. Electronic Devices and Circuits - J. Millman, Christos C. Halkias, 1991 edition, 2008, TMH.
2. Electronic Devices and Circuits- R.L. Boylestad and Louis Nashelsky, 9th edition, 2006, PHI.
3. Electronic Devices and Circuits – David A. Bell, Fifth Edition, 2008, Oxford University press.

REFERENCES:

1. Integrated Electronic - J.Millman and C.C.Halkias, Satyabratajit, 2nd edition, 1998, TMH.
2. Electronic Devices and Circuits - K. Lal kishore, 2nd edition, 2005, BSP.
3. Introduction to Electronic Devices and Circuits – Rober T. Paynter, PE
4. Electronic Devices and Circuits – S. Salivahana, N.Suresh Kumar.

EE2103 Signals and Systems

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

- To explain signals and systems representations/classifications and also describe the time and frequency domain analysis of continuous time signals with Fourier series, Fourier transforms and Laplace transforms.
- To teach Sampling theorem, describe the time and frequency domain analysis of discrete time signals with DTFS, DTFT and Z-Transform.
- To present the concepts of convolution and correlation integrals and also understand the properties in the context of signals/systems.
- To represent periodic signals using Fourier series.

- To analyze continuous signals using Laplace transform. To analyze discrete signals using z- transforms.

Course Outcomes:

- Identify different types of signal and systems properties that are commonly used in engineering.
- To mathematically represent and analyze the signals in time and frequency domains.
- Apply the Laplace Transform to the calculation of time responses of LTI systems.
- Evaluate convolution and correlation integrals and understand the signal comparison techniques and properties.
- Analyze the effect of the gain parameter of a closed-loop system on the stability of the system and the steady state error.

UNIT – I:Introduction

Classification of signals, Continuous-time signals and systems, signal characteristics; common signals, random signals, systems, and applications

UNIT – II:Signal parameters and Continuous LTI systems:

Signal parameters, The representation of signal in terms of impulses, LTI properties of continuous-time systems, impulse response, convolution, linear constant coefficient differential equations

UNIT – III:Fourier series and Fourier Transforms

Fourier series, Fourier and Laplace transforms, spectrum, statistical description of random signals, Properties of auto and cross-correlation, Ensemble averages, signal simulation.

UNIT – IV:Filter designing

System analysis, frequency response, Properties of power spectral density, analog filters, analog filter design, Butterworth filters, filtering of deterministic and random signals, system simulation, State-space analysis for continuous-time systems .

UNIT – V:Discrete time signals and systems

Discrete-time signals and systems, sampling, convolution, difference equations and digitization.

TEXT BOOKS:

1. Signals, Systems & Communications - B.P. Lathi, 2009,BS Publications.
2. Signals and Systems - A.V. Oppenheim, A.S. Willsky and S.H. Nawab, PHI, 2nd Edn.
3. Signals & Systems - Simon Haykin and Van Veen, Wiley, 2nd Edition .

REFERENCES:

1. Signals and Systems – A. Ramakrishna Rao - 2008, TMH.
2. Linear Systems and Signals – B. P. Lathi, Second Edition, Oxford University press, 2008.
3. Fundamentals of Signals and Systems Michel J. Robert, MGH International Edition, 2008.
4. Signals, Systems and Transforms - C. L. Philips, J. M. Parr and EveA. Riskin, Pearson education.3rd

EC2104 Electromagnetic Theory

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

- To explain the mathematical fundamentals necessary for understanding the electromagnetic theory.
- To teach the electrostatics and magnetic fields along with Maxwell's equations for EM Waves.
- To explain EM wave characteristics for understanding wave propagation.
- To explain wave guide concepts.
- To present the concepts of transmission lines, and this is a prerequisite course for "Antennas". To explain antenna parameters for characterizing its performance.

Course Outcomes:

- Students can understand physical interpretation of gradient, divergence and curl concepts and their applications for electromagnetic theory.
- students can able to understand relations between electric and magnetic field parameters from Maxwell's equations.
- They can understand uniform plane wave characteristics in lossy and lossless medium.
- They can understand impedance matching techniques and standing waves.
- They can understand basic parameters of antenna.

Unit I:

Maxwell's equations, displacement current, equation of continuity, boundary conditions.

Unit II:

Propagation of uniform plane waves in perfect dielectric and in lossy medium, polarization and poynting vector, reflection, refraction, phase and group velocities,

Unit III:

Transmission line: evaluation of line parameters, design concepts, cutoff frequency, attenuation, dispersion, power handling capacity.

Unit IV:

Travelling waves, standing waves, Smith chart and matching techniques, pulse propagation.

Unit V:

Radiation concept: elementary dipole, half wave dipole, radiation patterns, gain, pattern multiplication, basic antenna types.

TEXT BOOKS:

1. "Elements of Electromagnetics", Matthew N.O. Sadiku, 4thedition, 2008, Oxford University Press
2. "Engineering Electromagnetics", William H. Hayt Jr. and John A. Buck, 7thedition, 2006, TMH
3. "Networks Lines and Fields", John D. Ryder, 2ndedition, 1999, PHI

REFERENCE BOOKS:

1. "Electromagnetic Waves and Radiating Systems", E.C. Jordan and K.G. Balmain, 2ndedition.,2000, PHI
2. "Transmission Lines and Networks", Umesh Sinha, Satya Prakashan, 2001, (Tech. India Publications), New Delhi

BSBE 2001/3001 ENVIRONMENTAL SCIENCES

Externals: 60 Marks **(L-T)-P-C**
Internals: 40 Marks **4-0-3**

Course Objectives:

- To study the sources of water,floods and its impact on environment
- To know about the ecosystem and energy resource system
- To understand the Biodiversity concept and its advantages
- To study different types of pollution and its impact on environment
- To know the social and environment related issues and their preventive measures

Course outcomes:

- To get the idea about the relation between biotic and abiotic environment in nature
- To get the idea about the nature and the pollutants
- To get opportunity to know the value of bio diversity and threats of bio diversity
- To know about the conservation of biodiversity
- Ability to know the environmental impact

Unit - I

Environmental studies: Definition, scope and importance, need for public awareness.

Natural resources: Water resources; use and over utilization of surface and ground water, Floods, drought, conflicts over water, dams-benefits and problems. Effects of modern Agriculture, fertilizer-pesticide problems, water logging and salinity.

Unit - II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in ecosystem, food chains, ecological pyramids, aquatic ecosystem(ponds, streams, lakes, rivers, oceans, estuaries).

Energy resources: Growing energy needs renewable and non-renewable energy sources.
Land resources.land as resource, land degradation, soil erosion and desertification.

Unit - III

Biodiversity: Genetic species and ecosystem diversity, bio-geographical classification of India. Value of biodiversity, threats to biodiversity, endangered and endemic species of India, conservation of biodiversity.

Unit - IV

Environmental pollution: Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid and liquid waste management.
Environment protection act: Air, water, forest and wild life Acts, enforcement of Environmental legislation.

Unit - V

Social Issues and the Environment: Water conservation, watershed management, and environmental ethics. Climate change, global warming, acid rain, ozone layer depletion.
Environmental Disaster management: Types of disasters, impact of disasters on environment, infrastructure, and development. Basic principles of disaster mitigation, disaster management, and methodology, disaster management cycle, and disaster management in India.

Suggested readings:

1. A.K De, Environmental Chemistry,Wiley Eastern Ltd.
2. E.P. Odum, Fundamentals of Ecology,W.B. Sunders Co., USA.
3. M.N, Rao and A.K. Datta, Waste Water Treatment Oxford and IBK Publications.
4.Benny Joseph, Environmental Studies, Tata McGraw Hill, 2005.
5. V.K. Sharma, Disaster Management, National Centre for Disaster Management, IIPE, Delhi, 1999.

Reference:

1. Green Buildings Council of India, Teri Document.
2. GL. Karia and R.A. Christian, Waste Water Treatment, Concepts and Design Approach, Prentice Hall of Indian, 2005

HS2101 **Soft Skills I**

EXTERNAL: 60MARKS **L-T-P-C***
INTERNAL: 40MARKS **2-0-0-1**

Course Objectives:

1. To make the students to understand the pattern of the Various Competitive Exams

2. To make them to enhance Grammar, Comprehension and Vocabulary to appear for the Exams

3. To make them practice the sentence building, correct usage, comprehension, and composition

Course Outcomes:

1. Students will be able to get the clarity of various exams of SSC, AEE, TSPSC and UPSC

2. Students will be able to improve their Grammar, Comprehension and Vocabulary

3. Students will be able to get the confidence enough to appear for the Exams

Unit – I – Grammar-I

1. Previous question papers of AEE/TSPSC/SSC/Banking
2. Error Correction and Sentence Rearrangement
3. Clauses (Noun Clauses – Adjective Clauses; Adverbial Clauses) and Phrases (Noun phrases; verb phrases; adverbial phrases), If clauses
4. Types of sentences Positive/Negative/Interrogative/Negative interrogative
5. Transformations (Simple, Complex and Compound)

Unit – II – Grammar-II

1. Voice
2. Direct and Indirect Speech
3. Infinitives; Gerunds; Participles
4. Phrasal verbs; Idioms; Prepositional phrases
5. Forming Questions and Question Tags

Unit – III - Pronunciation

Aspects of Pronunciation

1. Consonant, Vowel Sounds and Diphthongs
2. Syllabification – Stress - Word Stress
3. Intonation: Falling – Raising – Falling and Raising

Unit – IV – Appreciation of poetry

Critical Appreciation of Selected Poems

Unit – V – Essay Writing

Opinion Essay – Argumentative Essay – Article Writing – Report Writing

REFERENCES:

5. R.P Bhatnagar and Bhargava Rajal, ***"English for Competitive Examinations".*** McMillan India limited, 2016.
6. Wren and Martin, NDV Prasad Rao. "***High School English Grammar and Composition*** *"* S. Chand& Compay Ltd, New Delhi.
7. Murali Krishna, ***"English for Engineers."***Pearson Education, Inc. New Delhi, 2015.
8. E. Suresh Kumar, P. Sreehari and J. Savithi**.** ***"English for Success."*** Foundation Books, Inc. New Delhi, 2014.

9. RS Agarwal, Vikas Agarwal, ***"Objective English"***S. Chand & Compay Ltd, New Delhi, 2016
1. http://www.bankexamstoday.com/2015/09/bank-exams-question-papers.html

EC2701 Electronic Circuits Lab

Externals: 60Marks **(L-T)-P-C**
Internals: 40Marks **0-3-2**

Course Objectives:
1. To study the electronics components and devices.
2. To study frequency response of RC circuits.
3. To study simple rectifiers circuits.
4. To study integrated circuits.
5. To study Logic Gates.

Course Outcomes:
- Understand the knowledge regarding electronic components and equipment.
- Understand Function Generator & CRO and its Applications.
- Design various filters.
- Design various rectifiers and regulators.
- Design of an amplifier.
- Verify the operation of Op-amp for various applications.
- Understand integrated circuits and Logic gates.
- Design various timers.

LIST OF EXPERIMENTS:

1. Familiarization with electronic components and usage of multimeter (measurement of resistance, classification of capacitors, diode testing)

2. Familiarization with Oscilloscope, signal generator and further usage of multimeters

3. Frequency response and square wave resting of R-C, C-R and R-L networks

4. Half-wave and full-wave rectifiers, rectification with capacitive filters, zener diode and IC regulation

5. Studies on CE amplifiers

6. Studies on Analog Circuits using OP-AMP

7. Studies on logic gates

8. Studies on 555 circuits, J-K flip-flop, counters and shift registers

EC2702 Semiconductor Devices Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

Course Objectives:

1. Fundamental concepts of semiconductor diodes and transistors.
2. Applications of various semi-conductor devices.
3. V-I Characteristics of special devices.
4. Transistor circuit behavior and their characteristics.
5. Electronic circuit design and simulation.

Course Outcomes:

1. Understand Characteristics of Diodes and Zener diodes.
2. Understand Characteristics of Transistors (CE&CB&CC).
3. Understand Characteristics of MOSFET.
4. Understand Characteristics of SCR/TRIAC.
5. Semiconductor Device Simulation.

LIST OF EXPERIMENTS:

1. JFET Characterization

2. Diode Breakdown Characteristics

3. Capacitance-Voltage characteristics of a PN junction (Doping Profile)

4. High frequency characteristics of BJT

5. SCR/TRIAC Characteristics

6. Hall Effect

7. MOS Capacitor Characterization

8. MOSFET Characterization

9. Bipolar Device Characterization

10. Semiconductor Device Simulation

11. MOS Capacitor Fabrication

EC2703 Basic Electronics Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

Course Objectives:

- To study the electronics components and devices.
- To study frequency response of RC circuits.
- To study simple rectifiers circuits.
- To study integrated circuits.
- To study Logic Gates.

Course Outcomes:

- Understand the knowledge regarding electronic components and equipment.
- Understand Function Generator & CRO and its Applications.
- Design various filters.
- Design various rectifiers and regulators.
- Design of an amplifier.
- Verify the operation of Op-amp for various applications.
- Understand integrated circuits and Logic gates.
- Design various timers.

LIST OF EXPERIMENTS:

1. Familiarization with electronic components and usage of multimeter (measurement of resistance, classification of capacitors, diode testing)

2. Familiarization with Oscilloscope, signal generator and further usage of multimeters

3. Frequency response and square wave resting of R-C, C-R and R-L networks

4. Half-wave and full-wave rectifiers, rectification with capacitive filters, zener diode and IC regulation

5. Studies on CE amplifiers

6. Studies on Analog Circuits using OP-AMP

7. Studies on logic gates

8. Studies on 555 circuits, J-K flip-flop, counters and shift registers

EC2901 Seminar - I

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **1-0-1**

Scheme of Internal Exam	: 25 Marks
Credits	: 1

Course Objectives:

Objective of the project seminar is to actively involve the students in preparation of the final year project with regard to following components:

- Problem definition and specification
- Literature survey, familiarity with research journals
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of graphs, bar (activity) charts and analyzing the results.
- Presentation - oral and written.

The evaluation is purely internal and will be conducted as follows:

Preliminary Report on progress of the work and viva	05 marks
Final report	05 marks
Presentation and Defence before a departmental committee consisting of Head, a senior faculty and supervisor	15 marks

Rajiv Gandhi University of Knowledge Technologies

Basar, Nirmal – 504107

B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

II YEAR II SEMISTER

Code	Subject	L-T	P	C
EC2201	Analog electronic Circuits	4	-	4
EC2202	Digital Electronics Circuits	4	-	4
EE2202	Linear Control System Engineering	4	-	4
MA2203	Probability Theory and stochastic process	4	-	4
CS2201	Computer Organization and Architecture	4	-	4
BM2201	Personality Development-I	2	-	1
EC2801	Analog electronic Circuits Lab	-	3	2
EC2802	Digital Electronics Circuits Lab	-	3	2
CS2801	Computer Organization and Architecture Lab	-	3	2
EC2902	Seminar-II	1	-	1

	Total	**23**	**9**	**28**

EC2201 Analog Electronics Circuits

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. The concepts of small signal equivalent circuits of BJT, FET and its frequency response.
2. The concept of multistage amplifiers, differential amplifiers and current mirrors for high input impedence.
3. The fundamental concepts of positive and negative feedback and their applications.
4. The performance analysis of Operational amplifiers and it's applictions.
5. The concept of large signal amplifiers and radio frequency amplifiers.

Course outcomes:

1. An ability to design and analyze the BJT & FET amplifiers at low frequency, mid frequency and high frequency regions.
2. An ability to design and perform the cascade amplifiers (i.e. multistage amplifiers) and its frequency response.

3. An ability to analyze a given differential amplifier or design a differential amplifier to meet the given specifications with constant current bias circuit.
4. An ability to design and analyze the positive feedback and negative feedback amplifiers for given specifications.
5. An ability to design and perform op-amp based circuits and it's applications for a given specifications.
6. An ability to understand the large signal amplifiers (i.e. power amplifiers) and its efficiency calculations.
7. An ability to understand the waveform generators, timers, ADCs, DACs and switched capacitor.

UNIT-I:Transistor Models:

Equivalent circuits using transconductance parameter for low and high frequency operation of BJTs and FETs, Ebers-Moll model view.

UNIT-II:Multistage Amplifiers:

Design and analysis of single and multistage amplifiers, wideband and narrowband amplifiers differential amplifiers ; current mirror- different configurations, Current source and Current sink.

UNIT-III:Feedback:

Feedback amplifiers, Y feedback, h and g negative feedback, oscillators and waveform generators, timers.

UNIT-IV:Operational Amplifiers:

Op-amp design: different stages of op-amp-a case study, active filter design, switched capacitor circuits , ADC , DAC.

UNIT-V: Power amplifiers:

Class AB/class B push-pull/class C

TEXT BOOKS:

1. Integrated Electronics – Jacob Millman, Christos C Halkias, Mc Grawhill.
2. Electronic Devices and Circuit Theory – Robert L.Boylestad, Louis Nashelsky, 9th edition, 2008 PE
3. Electronic Devices and Circuits- David A. Bell- 5th Edition, Oxford University Press.
4. Design of Analog CMOS Integrated Circuits – Behzad Razavi, 2008

REFERENCE BOOKS:

1. Electronic Circuits Analysis and Design – Donald A Neamen, Third Edition, Tata McGraw-Hill, 2007.
2. Introductory Electronic Devices and Circuits- Robert T. Paynter, 7th edition, 2009, PEI.
3. Microelectric circuits- sedra/ Smith- 5th edition, 2009, Oxford University Press.

4. Electronic Circuit Analysis- K.Lal Kishore, 2004, BSP.
5. Electronic Devices and Circuits – S.Salivahanan, N.Suresh Kumar, A. Vallavaraj, 2nd edition, 2009

EC2202 Digital Electronic Circuits

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. To understand the concepts of Number System and digital Conversion.
2. To understand the concepts of Boolean Algebra.
3. To learn basic techniques for the design of digital circuits and fundamental concepts used in the design of digital systems.
4. To understand the concepts of various combinational and sequential circuits.
5. To learn various techniques for logic circuit reduction.

Course Outcomes:

1. Convert decimal number into binary, octal and hexa decimal system and also to apply them for real life problems.
2. Design simple logical operations.
3. Design efficient combinational and sequential circuits from functional description of digital system
4. The ability to identify and prevent various hazards and timing problems in a digital design.
5. Design the circuits for any real life problems with the knowledge of digital systems.

UNIT-I: **INTRODUCTION**

Digital & analog signals, Number System, BCD & its arithmetic, Binary, Decimal, Hexadecimal, Negative numbers& its arithmetic, Number base conversions, Octal

UNIT-II: BOOLEAN ALGEBRA&SIMPLIFICATION TECHNIQUES

Duality Principals & Canonical Form, K-Maps

UNIT-III: LOGIC GATES

All Logic Gates & Implementations

UNIT-IV: COMBINATIONAL LOGICS

Adders, Array Multiplier Code Converters, Comparators, Decoders (DeMultiplexers), Encoders, Multiplexers, Parity Generators Checkers,Subtractors

UNIT-V:SEQUENTIAL LOGIC CIRCUITS

Asynchronous Circuits, Synchronous Circuits, Flip-Flops, Master SlaveOperation Flip-Flop, Counters, State Machine, Pattern Identifier

TEXTBOOKS:

1. Switching & Finite Automata theory – Zvi Kohavi, TMH,2nd Edition.

2. Digital Design – Morris Mano, PHI, 3rd Edition, 2006.

3. Switching Theory and Logic Design-A.Anand kumar, 2008.

REFERENCES:

1. An Engineering Approach to Digital Design – Fletcher, PHI.

2. Fundamentals of Logic Design – Charles H. Roth, 5th Edition, 2004, Thomson Publications.

3. Digital Logic Applications and Design – John M. Yarbrough, 2006.

EE2202 Linear Control System Engineering

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. The ability to understand the characteristics of various types of nonlinearities present in physical systems.
2. The ability to carry out the stability analysis of non-linear control systems.
3. The ability to carry out the analysis and design of digital control systems.
4. The ability to represent digital control systems using state space models.
5. The ability to analyze the effect sampling on stability, controllability and observability.

Course outcome:

1. The ability to understand the characteristics of various types of nonlinearities present in physical systems.
2. The ability to carry out the stability analysis of non-linear control systems.
3. The ability to design compensators for digital control system to achieve desired specifications.
4. The ability to represent digital control systems using state space models.
5. The ability to analyze the effect sampling on stability, controllability.

UNIT – I: INTRODUCTION

Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects ofFeedback, Mathematical modeling of physical systems: Differential equation and Transfer functions , Examples of modeling different types (e.g. electrical, mechanical, chemical, biological, social etc.) of systems, Equivalence between the elements of different types of systems. Block diagram algebra –Signal flow graph -Reduction using Mason‘s gain formula.

UNIT -II : CHARACTERIZATION OF SYSTEMS

Time Domain Analysis: Standard test signals - Time response of first order systems –Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications, Steady state response - Steady state errors and error constants, Frequency domain response -- Transfer function and its interpretation in terms of frequency responses peak and peaking frequency, bandwidth and cut-off rate; Link between time and frequency domain response features. Advantages of closed loop operation: Sensitivity and complementary sensitivity, Disturbance and noise reduction. Effects of proportional, integral, derivative Controls.

UNIT – III: STABILITY ANALYSIS IN S-DOMAIN

The concept of stability – Routh‘s stability criterion – qualitative stability and conditional stability – limitations of Routh‘s stability. The root locus concept - construction of root loci- and relative stability using root-locus approach ,effects of adding poles and zeros to G(s)H(s) on the root loci.

UNIT – IV: STABILITY ANALYSIS IN FREQUENCY DOMAIN

Polar Plots-Nyquist Plots-Stability Analysis. Bode diagrams- Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain margin-Stability Analysis from Bode Plots. P, PD, PI, PID Controllers and Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain,

UNIT – V: STATE SPACE ANALYSIS OF LINEAR CONTINUOUS SYSTEMS

Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it‘s Properties.

TEXTBOOKS:

1. Automatic Control Systems– by B. C. Kuo and Farid Golnaraghi – John wiley and son‘s, 8th edition, 2003.
2. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited,Publishers, 5th edition, 2007.

REFERENCE BOOKS:

1. Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 5th edition, 2010.
2. Control Systems Engineering - by NISE 5th Edition – John wiley.

MA2203 Probability Theory and Stochastic Processes

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

- To understand the concepts of random variables, expectation, Variance.
- To learn various distributions and their applications.
- To study the properties of convergence of random variables and Central Limit theorem.
- To learn the concept stochastic process and study various types of stochastic processes.

Course Outcomes:

- Use basic counting techniques (multiplication rule, combinations, permutations) to compute probability and odds.
- Compute conditional probabilities directly and using Bayes' theorem, and check for independence of events.
- Set up and work with discrete random variables. In particular, understand the Bernoulli, binomial, geometric and Poisson ,Negative Binomial, Hyper-geometric distributions
- Work with continuous random variables. In particular, know the properties of uniform, normal and exponential distributions.
- Know what expectation and variance mean and be able to compute them.
- Understand the law of large numbers and the central limit theorem.
- Compute the covariance and correlation between jointly distributed variables.
- Evaluate and apply moments & characteristic functions and understand the concept of inequalities and probabilistic limits.
- Understand the concept of random processes and determine covariance and spectral density of stationary random processes.

- Demonstrate the specific applications to Poisson and Gaussian processes and representation of low pass and band pass noise models.

UNIT-I

Basic concepts of Probability**:** Random experiment. Sample space.Mutually exclusive events. . Problems based on probability. Properties based on axiomatic definition of probability. Conditional probability.Independent events.

Random Variables**:** Definition of random variables. Properties of discrete and continuous random variables. Definition and properties of probability mass function and probability density function. Definition of cumulative distribution function and its properties for discrete and continuous distributions.

Multivariate Distributions:Definition and properties of multivariate distribution (continuous and discrete). Joint probability distributions.Marginal probability distributions.Conditional probability distributions.

Mathematical Expectation:Concept of mathematical expectation of functions of random variables and their significance.

UNIT-II

Discrete Distributions: Properties of various discrete distributions: Binomial, Poisson, Negative Binomial, Geometric, Hypergeometric and Discrete uniform distributions.
Continuous Distributions: Properties of various continuous distributions: Uniform, Exponential, Normal, Gamma distributions.

Functions of Random Variables: Evaluating probability distribution of functions of random variables using CDF technique. Determination of joint probability distribution of functions of random variables using transformations.Using transformations to evaluate the distribution of functions of random variables.

UNIT –III

Moments and MomentGenerating Functions: Moments about origin, Central moments. Moment generating functions of random variables and its properties.

Covariance and Correlation: Definition and properties of covariance and correlation. Definition of bivariate normal distributions.Properties of its marginal distributions.

Inequalities : Chebychev's inequality, Cauchy Schwarz inequality. Convergence in probability.

UNIT-IV

Ordered Statistics: Probability distributions of ordered statistics and their properties.
Various types of Convergence of random Variables, Weak law of Large numbers(WLLN), Strong Law of large numbers (SLLN),Central Limit theorem

Stochastic Process

Definition of Stochastic process, Classification (Discrete & Continuous),Methods of Description of Stochastic Process(First order, distribution,density,2nd order distribution and density),Special classes of Stochastic process, Markov process, Process with independent increaments,Stationary process.
Mean Auto Correlation function and its Properties, Auto Covariance function, Strict Sense Stationary, Wide Sense Stationary, Ergodic and Gaussian Random Processes.
Cross Correlation and Cross Co variance

UNIT-V

Stationary Stochastic Processes, Power spectral density, Examples of speech signals, Wiener-Kinchine theorem, White Noise.

Special Stochastic Processes, Poisson Process, Gaussian process, Markov Chains Process depending on stationary Gaussian process.

Text Books:

1. A. Papoulis: Probability, Random Variables and Stochastic Processes
2. Gupta, S.C., Kapoor V.K., Fundamentals of Mathematical Statistics (11th Edition), Sultan Chand & Sons, 2002.
3. Ross, S.M., Introduction to Probability and Statistics for Engineers and Scientists (4th Edition), Academic Press, 2011.

References:

1. E. Parzen, Introduction to Probability
2. H.L. Van Trees Detection, Estimation and Modulation Theory Part-I,Wiley, 1968
3. J.B. Thomas, Introduction to Probability Springer Verlag 1986
4. W.B. Davenport Jr. Probability and Random Processes: An Introduction to

Applied Scientists and Engineers Mc-Graw Hill 1970
5. C.W. Helstrom Probability and Stochastic Processes for Engineers, 2nd ed,Macmillan 1990
6. Scott L. Miller and Donald Childers, Probability and Random processes, Elsevier 2011.
7. George R. Cooper and Clare D. McGillen, Probabilistic Methods of Signal and System analysis, Oxford University Press, 2009.
8. Oliver C. Ibe, Fundamentals of Applied probability and Random processes, Academic press (an imprint of Elsevier), 2010.

CS2201 Computer Organization & Architecture

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

- To understand how Computer Systems work & its basic principles
- To learn how to analyze the system performance.
- To understand the concepts behind advanced pipelining techniques.
- To learn the current state of art in memory system design
- To understand how I/O devices are being accessed and its principles.
- To provide the knowledge on Instruction Level Parallelism

Course Outcomes:

- Understand the major components of a computer including CPU, memory, I/O and storage.
- Understand the basic components of the CPU including the ALU and control unit.
- Understand complete instruction set of a processor.
- Understand the uses for cache memory.
- Understand a wide variety of memory technologies both internal and external.
- Understand the role of the operating system in interfacing with the computer hardware.
- Will have a basic understanding of assembly programming.
- Design principles in instruction set design including RISC architectures.
- Understand parallelism both in terms of a single processor and multiple processors.

Unit I:

Basic functional blocks of a computer, Basic Functional blocks - CPU, Memory, Input-output, Control unit, Instructions and Instruction execution cycle, Instruction set architecture-Elements of machine instructions, Instruction representation, Instruction types, classification based on number of addresses, Data types, Types of operations-Data transfer, Arithmetic, Logical, Conversion, Input-output, system, Control and transfer of control operations, Addressing modes, Case study of 8086 instruction set.

Unit II :

Data representation and Arithmetic Data Representation: signed number representation, fixed and floating point representations, character representation. Converting between different b it lengths, Integer arithmetic: Negation, integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication shift-and-add, and Booth multiplier Division nonrestoring and restoring techniques, floating point : floating point representation and floating point arithmetic: Addition, Subtraction, Division, Multiplication

Unit III :

CPU control unit design Micro operations : fetch, indirect, interrupt, execute, Instruction cycle, Control Signals: inputs and outputs, Hard Wired Control Unit, Micro instructions: horizontal and vertical instruction formats, Micro program, Micro programmed control unit, Advantages and Disadvantages of hardwired and Micro programmed control unit Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards

Unit IV :

Input-output organization External devices, Input -output Interface: I/O Bus and interface Modules, I/O Versus memory Bus, I/O Modules structure and their functions, Modes of Transfer: Programmed I/O, Interrupt driven I/O, Direct Memory Access: DMA Controller and Transfer, DMA Configurations, Privileged and Non-privileged instructions, Software Interrupts and exceptions, Processor modes: User mode and kernel mode.

Unit V :

Semi-conductor main memory & Memory organization Memory Hierarchy, Main Memory: Semiconductor main memory, Organization of memory cell, RAM: DRAM, SRAM and ROM Chips, Memory Connection to CPU. Auxiliary memory: Disks, Read and write mechanisms, Data organization and formatting, Physical Characteristics, Disk performance parameters, Overview of optical discs, Memory Organization: Memory Interleaving, Cache memory, Cache memory principles, Mapping functions: Direct mapping, Associative mapping function,Set-Associative mapping function, Replacement Algorithms, Write policy.

Suggested Reading:

1. William Stallings, Computer Organization & Architecture, 6thdition, Pearson Education Asia

2. M.Morris Mano, Computer System Architecture,3rd edition, Pearson Education Asia

3. V.Carl Hamacher, Z.G.Vranesic, S.G.Zaky, Computer organization, McGraw Hill.

BM2201 PERSONALITY DEVELOPMENT 1

EXTERNAL: 60MARKS **L-T-P-C***
INTERNAL: 40MARKS **2-0-0-1**

Guidelines: Learning approach is based on Real time case studies with class room activities

Course Objectives:

1. To develop interpersonal skills and be an effective goal oriented team player.
2. To develop professionals with idealistic, practical and moral values.
3. To develop communication and problem solving skills.
4. To re-engineer attitude and understand its influence on behavior.
5. To enhance holistic development of students and improve their employability skills.

Course Outcomes:

After the successful completion of this course, the learner will be able to know:

1. Self analysis and self analysis techniques there by learning the various aspects of their personality.
2. SWOT Analysis, and use SWOT in their life for various opportunities.
3. Set Goals and prioritize their resources to achieve them.
4. Diversify career risk and optimize results.
5. Understand; realize the importance of team work.

6. Upgrade their interpersonal skills.
7. Overcome fear of public speaking and effective group participation.
8. How to think in a creative way and rationalization of ideas.

UNIT I-SELF ANALYSIS

SWOT Analysis, Who am I, Personality Traits, Importance of Self Confidence, Self Esteem.

UNIT II-GOALS SETTINGS

Short term , Long term goal settings, SMART concept

Diversifying Risk and Optimizing Returns

UNIT III- Team Dynamics with Interpersonal Skills

Team Dynamics, Team Work, Interpersonal Skills

Behavioral Skills GD, PI, Body Language Public Speaking, Verbal, Non Verbal Communications

UNIT IV-CREATIVITY and Rationality

Out of Box thinking, Idea Generation with creativity

Brain Storming, Effective group meetings, Rationalization of ideas and way to effective implementation

Note: Class room activities coupled with group tasks will be taken depending upon time availability

EC2801 Analog Electronic Circuits Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

Course Objectives:

1. To Design and Characterize of small signal equivalent circuits of BJT, FET/MOSFET and its frequency response.
2. To Design of multistage amplifiers, differential amplifiers and current mirrors for high input impedance.
3. To Design of positive and negative feedback and their applications.
4. To Design of Simple and Cascode current mirror circuits using BJT and MOSFET
5. To Design and test various types of oscillators
6. To Design the Power amplifier circuit and its applications

Course Outcomes:

1. An Ability to compute the parameters from the characteristics of JFET and MOSFET devices and its application
2. Ability to Design, test and evaluate BJT amplifiers in CE, CB, CC configuration and its application
3. An ability to Design and test JFET/MOSFET amplifiers and its application
4. An ability to Design and test a power amplifier and its application
5. An ability to Design and test various types of oscillators and its application

6. An ability to Design and test various types of filters and its application
7. An ability to Design and test various types of Timers and its application

LIST OF EXPERIMENTS:

1. D.C. characterization and finding ac model parameters of a BJT.

2. D.C. characterization and finding ac model parameters of a MOSFET.

3. Design of feedback amplifiers with BJT.

4. Design of amplifiers with MOSFET.

5. Design and characterization of simple current mirror circuits using BJT and MOSFET.

6. Design and characterization of cascode current mirror circuits using BJT and MOSFET.

7. Design of Common collector amplifier

8. Design of differential amplifier using BJT with resistive load.

9. Design of differential amplifier using MOSFET with active load.

10. Design of R-C and L-C oscillators (phase shift/Colpitt/Hartley).

11. Design of a tuned amplifier.

12. Design of a second order active filter (low pass/high pass/band pass)

13. Design of a timer.

EC2802 Digital Electronic Circuits Lab

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**0-3-2**

Course Objectives:

1. To learn differences between analog systems and digital systems.
2. To learn basic techniques for the design of digital circuits.
3. To understand fundamental concepts used in the design of digital systems.
4. To understand the concepts of various combinational and sequential circuits.
5. To learn various techniques for logic circuit reduction.

Course Outcomes:

1. Design, Analysis, Implementation and testing of logic gates and functions.
2. An ability toanalyze, implement and testing of combinational circuits.
3. Design, Analysis, Implementation and testing of flip-flops and registers.
4. An ability to analyze, implement and testing of counters.
5. Design, Analysis, Implementation of application level projects.

LIST OF EXPERIMENTS:

1. Functioning of monoshot, shift register, master slave flip flop, ALU

2. Design of a counter asynchronous and synchronous

3. I/O characteristics of a NAND gate

4. Design of a digital comparator

5. Design of a full adder circuit

6. Design of a multiplexer

7. Design of a 7-segment LED display

8. Design of an ALU.

CS2801 Computer Organization & Architecture Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

This course concentrates on the practical part of Computer Organization by using Assembly language. This course allows students to practice writing programs based on the concepts the will learn through the course by giving the students different types of problems to be solved using an emulator.

Course Objectives:

- Teach students basic principles about computer architecture, machine language, and low-level programming.
- Teach students enough assembly language to enhance their knowledge on today's most widely used microcomputer family.
- Improving students systems programming skills through programming exercises carried out by students.
- Students are expected to implement solutions to problems using the concepts they will take through the course.

Course Outcomes:

- Understand the concepts of microprocessors and internal architecture of 8086 microprocessor
- Understand the difference between High level languages and machine language.
- Design the programs to perform simple arithmetic and Logical operations
- Apply the concepts of arrays and procedures to design efficient programs

Experiments:

1. Basic Concepts
2. Assembly Language Fundamentals
3. Data Transfers, Addressing, and Arithmetic
4. Procedures
5. Conditional Processing
6. Integer Arithmetic
7. Strings and Arrays
8. 16-Bit MS-DOS Programming

For the detailed list of programs refer the lab manual.

Note: Any experiment according to the syllabus of CS2201 can be substituted

EC2902 Seminar - II

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**1-0-1**

Scheme of Internal Exam	: 25 Marks
Credits	: 1

Course Objectives:
Objective of the project seminar is to actively involve the students in preparation of the final year project with regard to following components:

- Problem definition and specification
- Literature survey, familiarity with research journals
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of graphs, bar (activity) charts and analyzing the results.
- Presentation - oral and written.

The evaluation is purely internal and will be conducted as follows:

Preliminary Report on progress of the work and viva	05 marks
Final report	05 marks
Presentation and Defence before a departmental committee consisting of Head, a senior faculty and supervisor	15 marks

Rajiv Gandhi University of Knowledge and Technology

Basar, Mudhole, Adilabad – 504107

B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

III YEAR
I SEMISTER

Code	**Subject**	**L-T**	**P**	**C**
EC3101	Analog communications	4	-	4
EC3102	RF and Microwave Engineering	4	-	4
EC3103	Digital Signal Processing	4	-	4
EC3104	VLSI Engineering	4	-	4
BM3001/4001	Managerial Economics and Financial Analysis	4	-	3
BM3101	Personality Development-II	2	-	1
EC3701	Analog communications Lab	-	3	2
EC3702	RF and Microwave Engineering Lab	-	3	2
EC3703	Digital Signal Processing Lab	-	3	2
EC3901	Seminar-II	1	-	1
	Total	**23**	**9**	**27**

EC3101 Analog Communications

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. To introduce information source, basic communication channels, and some basic mathematical background for bandpass signal representation.
2. To introduce the basic components of communication system.
3. The design procedure of AM and FM transmitters and receivers.
4. To learn the random variables and random processes, needed for noise analysis.
5. Performance analysis of analog communication systems in the presence of noise, by using SNR and Figure of merit as measures of performance.

Course Outcomes:

1. Students will get awareness of communication system components like, source, transmitter, channel, receiver.
2. Students will get strong mathematical background needed for theoretical analysis of analog communication systems.
3. Students will learn how to design AM and FM transmitters and receivers.
4. Students will learn basics of analog television transmission and stereo FM broadcasting.
5. Students will learn how to analyze the performance of analog communication systems like FM, AM.

UNIT-I: INTRODUCTION

Types of information sources, communication channel, Hilbert transform Analytical representation of band pass signals

UNIT-II: MODULATION TECHNIQUES

Fundamentals of analog signals transmission, AM, SSB, DSB-SC, VSB, Ring modulator, FM, PM

UNIT – III: FEEDBACK DEMODULATORS

Phase locked loop (PLL), Frequency compressor feedback demodulation, FM receivers

UNIT – IV:RANDOM PROCESS

Review of probability theory and random process

UNIT – V:BHEHAVIOUR OF COMMUNICATION SYSTEM IN THE PRESENCE OF NOISE

Performance of AM system in noise, Noise in AM and Angle modulation system, Noise in PM and FM modulation system

TEXT BOOKS:

1. A. Bruce Carlson, & Paul B. Crilly, ―Communication Systems – An Introduction to Signals & Noise in Electrical Communication‖, McGraw-Hill International Edition, 5th Edition, 2010.

2. Sham Shanmugam, ―Digital and Analog Communication Systems‖, Wiley-India edition, 2006.

REFERENCES:

1. Simon Haykin, ―Communication Systems‖, Wiley-India edition, 3rd edition, 2010.
2. B.P. Lathi, & Zhi Ding, ―Modern Digital & Analog Communication Systems‖, Oxford University Press, International 4th edition, 2010.
3. Herbert Taub & Donald L Schilling, ―Principles of Communication Systems‖, Tata McGraw-Hill, 3rd Edition, 2009.
4. R.E. Ziemer & W.H. Tranter, ―Principles of Communication- Systems Modulation & Noise‖, Jaico Publishing House, 2001.
5. George Kennedy and Bernard Davis, ―Electronics & Communication System‖, TMH, 2004

EC3102 RF AND MICROWAVE ENGINEERING

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. To prepare students to understand basic principle of microwave and its frequency bands & it's utilities.
2. To prepare students to understand different microwave components & transmission lines and analyzing different type of junctions used in microwave engineering.
3. To teach the students about various microwave sources and their characteristics.
4. To teach the students about various microwave solid-state devices and their characteristics.
5. To understand microwave filter design concepts, wave propagation and microwave applications.

Course Outcomes:

1. Become proficient with microwave measurement of power, frequency and VSWR, impedance for analysis of circuits.
2. Understand the principles of operation of waveguide, isolator attenuator etc. and obtain scattering matrix for various junctions like E-plane, H plane, Circulator, Direction Coupler.
3. Ability to analyze the working principle and characteristics of microwave sources.
4. Ability to analyze the microwave solid state devices and it's characteristics & analyze avalanche transit devices.
5. Ability to design microwave filter and analyze the microwave propagation and its applications.

UNIT-I:MICROWAVE BANDS & MEASUREMENTS

Introduction, Microwave radiation spectrum and bands, Phase variation, Transit time effect, Microwave test bench setup, measurement of power, frequency, phase, attenuation, impedance, quality factor & VSWR.

UNIT-II:MICROWAVE TRANSMISSION & COMPONENTS

Microwave Transmission Lines: Rectangular waveguide & circular waveguide. Cavity resonators, E-plane, H-plane Tee junctions and E-H plane (hybrid or Magic) Tee, Directional couplers, Faraday rotation principle,isolator, circulator.Scattering matrix-significance, formulation and properties. S-matrix for: E-plane, H-plane Tees, Magic Tee, circulator and isolator.

UNIT-III:MICROWAVE SOURCES

Microwave tubes: O-type and M-type classifications.Construction, theory of operation and applications of Two-cavity klystron and Reflex Klystron.Construction principle of operation and applications of Helix TWT and cavity magnetron (qualitative treatment).

UNIT-IV:MICROWAVE SOLID STATE DEVICES

Introduction, Transferred Electron Devices (TED's): Gunn Effect devices, domain formation, transit time Domain mode, Delayed and Quenched Domain mode, Limited space charge accumulation mode, construction of Gunn diode, typical characteristics, Gunn Diode oscillator and applications of Gunn diode. Principal of operation of: IMPATT Diode, TRAPATT Diode and BARITT Diode.

UNIT-V: STRIP LINES &MICROWAVE FILTER DESIGN

Strip lines and microwave filter design: Image parameter method & insertion loss method. Microwave propagation and applications of microwave engineering.

TEXT BOOKS:

1. Microwave devices and circuits-Samuel Y. Liao, Pearson, 3rd Edition, 2003.

2. Microwave principles-Herbert J.Reich, J.G.Skalnik, P.F.Ordung and H.L.Krauss, CBS publishers and distributors, New Delhi, 2004.

3.Microwave engineering- David M. Pozar, fourth edition, john wiley& Sons Inc. publications.

REFERENCES:

1. Foundations for microwave engineering-R.E.Collin, IEEE press, John Wiley, 2nd edition, 2002.

2. Microwave circuits and passive devices-M.L.Sisodia and G.S.Raghuvanshi,Wiley Eastern Ltd., New age International publishers Ltd., 1995.

3. Microwave engineering passive circuits-Peter A.Rizzi, PHI, 1999.

4. Electronic and Radio Engineering-F.E.Terman, McGraw-Hill, 4th Edition, 1995.

5.Microwave and Radar engineering- Dr. M. Kulakarni, Umesh publications, fifth edition, 2015

EC3103 Digital Signal Processing

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**4-0-4**

Course Objectives:

1. To learn DFT, FFT and convolution concepts.
2. To learn the basics of Multirate digital signal processing and its applications.
3. To get the response of linear phase systems and all pass systems.
4. To design digital IIR and FIR filters for the given specifications.
5. To learn the DSP processor architecture for the efficient implementation of digital filters.

Course outcomes:

1. Understand DFT and convolution concepts and transformations.
2. Understand and develop Multirate digital signal processing systems.
3. Get the response of linear phase systems and all pass systems.
4. Design and implement digital finite impulse response (FIR) & infinite impulse response (IIR)filters.
5. Analyze discrete-time systems in both time & transform domain and also through pole-zero placement.

UNIT-I Discrete signals and Systems:

Discrete signals and Systems in time domain, typical signals, sampling process, discrete time systems(DTS), time domain characterizations of LTI ,DTS classification of LTI, DTS , Discrete time signals in frequency domain -DTFT DFT ,computation of DFT, linear convolution using DFT Z-transform

UNIT-II:

LTI & DTS in the frequency domain transfer functions, frequency response, simple digital filters, all pass functions, complementary transfer functions, digital two pairs, sampling and reconstruction

UNIT-III:

Digital filter structures-Direct, parallel, cascade ladder and lattice for IIR, possible realizations for FIR including polyphase, all pass structures, tunable filters

UNIT-IV:

Digital filter design – IIR using impulse invariant and bilinear transformations, spectral transformations, FIR design using windowing, frequency sampling and computer aids,

UNIT-V:

Implementation considerations

TEXT BOOKS:

1. Digital signal processing, principles, Algorithms and applications: John G. Proakis, Dimitris G. Manolakis, Pearson Education/PHI, 4th ed., 2007.

2. Digital signal processing , A computer base approach- Sanjit K Mitra, Tata Mcgraw Hill, 3rd edition, 2009.

3. Discrete Time Signal Processing-A.V. Oppenheim and R.W. Schaffer, 2nd ed., PHI.

REFERENCES:

1. Digital signal processing: Andreas Antoniou, TATA McGraw Hill, 2006.

2. A Text book on Digital Signal processing – R S Kaler, M Kulkarni,, Umesh Gupta, I K International Publisthing House Pvt. Ltd.

3. Digital signal processing: M H Hayes, Schaum's outlines, TATA Mc-Graw Hill, 2007.

EC3104 VLSI Engineering

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. To study the MOS transistors with their characteristics succeeded by the fabrication process.
2. Making aware of VLSI design flow and gaining knowledge on protocols required to obtain the digital logic layout designs.
3. Understanding various subsystem design concepts by realizing Circuits design in terms of System design.
4. Acquiring the knowledge in basic concepts of VHDL and its abstraction levels followed by simulation and synthesis.
5. To understand the need for testing a chip by applying their Engineering skills in VLSI design to the challenges in industry.

Course Outcomes:

1. Students will be Analyzed with various processing steps involved in IC on monolithic devices followed by understanding MOSFETS electrical properties.
2. Applying the knowledge of layout, stick diagrams, static and switching characteristics of inverters by CMOS technology for designing a sequential circuit.
3. Students will be good at Realizing CMOS as a switch and its technology for designing a combinational circuit by implementing it using transmission gate/PLD's.
4. Students will be knowing the ability to identify, formulate, and analyze by creating an ability to use the techniques, skills and modern EDA tools necessary for design and test of VLSI circuits by keeping aware of contemporary issues.
5. Students will be good at designing VLSI systems by keeping a view on the design for testability concepts.

UNIT I: INTRODUCTION

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS &BiCMOS technologies- Oxidation, Lithography, Diffusion, Ion implantation, Metallisation, Encapsulation, Probe testing, Integrated Resistors and Capacitors. Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds, figure of merit o; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT II: VLSI CIRCUIT DESIGN PROCESSES

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 m CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

UNIT III :GATE LEVEL DESIGN

Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Basic circuit concepts, Sheet Resistance RS and its concept to MOS, Area Capacitance Units, Calculations – - Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out,Choice of layersSUBSYSTEM DESIGN : Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators,Comparators, Zero/One Detectors, Counters, High Density Memory Elements.

UNIT IV :SEMICONDUCTOR INTEGRATED CIRCUIT DESIGN

PLAs, FPGAs, CPLDs, Standard Cells, Programmable Array Logic, Design Approach. VHDL SYNTHESIS : VHDL Synthesis, Circuit Design Flow, Circuit Synthesis, Simulation, Layout, Design capture tools, Design Verification Tools, Test Principles.

UNIT V:CMOS TESTING

CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chiplevel Test Techniques, System-level Test Techniques, Layout Design for improved Testability.

TEXTBOOKS :

1. Essentials of VLSI circuits and systems – Kamran Eshraghian, EshraghianDougles and A. Pucknell, PHI, 2005 Edition.
2. Principles of CMOS VLSI Design – Weste and Eshraghian, Pearson Education, 1999.

REFERENCES :

1. Chip Design for Submicron VLSI: CMOS Layout & Simulation, – John P. Uyemura, Thomson Learning.
2. Introduction to VLSI Circuits and Systems – John .P. Uyemura, JohnWiley, 2003.
3. Digital Integrated Circuits – John M. Rabaey, PHI, EEE, 1997.
4. Modern VLSI Design – Wayne Wolf, Pearson Education, 3rd Edition, 1997.
5. VLSI Technology – S.M. SZE, 2nd Edition, TMH, 2003.

BM3001/4001 Managerial Economics and Financial Analysis

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objective:

- Enable the students to learn managerial economics principles applied in industries and equip them to handle the tasks in their career by making a real sense of what is happening economically in the organization.
- The course describes the Nature and Scope of Managerial Economics. It gives complete study on the demand and elasticity of demand and methods of demand forecasting.
- It provides a detailed structure on the pricing strategies and shows clear picture methods and sources of raising finance.
- It gives clear cut information of preparing final accounts and capital Budgeting techniques.

Course Outcome:

After the successful completion of this course, the learner will be able to know:

1. The dynamic game of demand and supply, and how the trinity of Economics i.e. Demand, Supply and Scarcity make the things move around the globe.
2. Principles of Microeconomics applied to industries.
3. Concept of forecasting and applying forecasting techniques to address the challenges and opportunities in the organization they work.
4. Cost and Production analysis, Break-Even analysis, Opportunity Cost, how to optimize organizational resources and how to minimize cost and maximize production, revenue and profit
5. Different pricing structure and discount mechanism suitable for business firms.
6. Market structure and how to exploit market structure for optimizing the benefits of organization.
7. Capital requirements and sources of capital.

UNIT I: Introduction to Managerial Economics:

Definition, Nature and Scope of Managerial Economics-Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting.

UNIT II: Theory of Production and Cost Analysis:

Production Function - Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs. Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale.

Cost Analysis: Cost concepts, Opportunity cost. Fixed vs. Variable costs, Explicit costs Vs. Implicit costs. Out of pocket costs vs. Imputed costs. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems)- Managerial Significance and limitations of BEA.

UNIT III: Markets & Pricing Policies:

Market structures: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. Objectives and Policies of Pricing- Methods of Pricing: Cost Plus Pricing. Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing.

UNIT IV: Introduction to Financial Accounting: Introduction to Financial Accounting: Double entry Book Keeping, Journal, Ledger, Trail Balance and Final Accounts (Trading account, Profit and Loss Account and Balance sheet with simple adjustments).

UNIT V: Capital and Capital Budgeting:

Capital and Capital Budgeting: Capital and its significance. Types of Capital. Estimation of Fixed and Working capital requirements. Methods and sources of raising finance. Nature and scope of capital budgeting, features of capital budgeting proposals. Methods of Capital Budgeting: Payback Method. Accounting Rate of Return (ARR) and Net Present Value Method, Internal Rate of Return (IRR).

Reference Books:

1. Aryasri: Managerial Economics and Financial Analysis, TMH,2009.
2. Varshney & Maheswari : Managerial Economics, Sulthan Chand,2009.
3. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis, Scitech. 2009.
4. V.Rajasekarn & R.Lalitha. Financial Accounting, Pearson Education. New Delhi. 2010
5. Suma Damodaran, Managerial Economics, Oxford University Press. 2009.

BM3101 PERSONALITY DEVELOPMENT –I I 2-0-1

Guidelines: Learning approach is based on Real time case studies with class room activities

Course Objectives:

1. To develop interpersonal skills and be an effective goal oriented team player.
2. To develop professionals with idealistic, practical and moral values.
3. To develop communication and problem solving skills.
4. To re-engineer attitude and understand its influence on behavior.
5. To enhance holistic development of students and improve their employability skills.

Course Outcomes:

After the successful completion of this course, the learner will be able to know:

1. Students will bring out optimistic aspects of their personality whereas suppress pessimistic one.
2. Internal and External motivating factors to keep themselves motivated in testing times.
3. Learn different leadership styles and choose one which suits them.
4. Communicate effectively and can act as change agent in the fast moving dynamic world.
5. Would identify the crisis and problems, and be able to address them through suitable channel.

.UNIT I-ATTITUDE

Factors influencing attitude, Challenges and lessons from Attitude, Etiquette and Confidence.

UNIT II-MOTIVATION

Motivation Theories, Factors of motivation, Self talk, Intrinsic & Extrinsic Motivators.

Maslow's Motivation Theory, Herzberg theory, Hygiene theory, XY theory.

UNIT III-LEADERSHIP

Leadership Styles, Skills for a good Leader, Assessment of Leadership Skills.

UNIT IV- Communication Management, Change Management, Crisis Management Meaning, Types of communication, Barriers to effective communication, using communication skills to manage conflicts. Change Management: Internal, External parameters, Business communication. e-mail writing, Presentations, Report writing , Letters etc…Feedback System

Class room activities coupled with group tasks will be taken depending upon time availability

EC3701 Analog Communications Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

Course Objectives:

1. To design and implement the modulation and demodulation circuits used in analog communication systems.
2. To get the feel of frequency division multiplexing.

Course Outcomes:

After completing this lab, students will learn:

1. How to design basic analog communication system components like amplitude modulators and demodulators, filters, AGC and understanding frequency modulation and demodulation and carrier recovery circuits.
2. Frequency division multiplexing and de-multiplexing of analog signals.

LIST OF EXPERIMENTS:

1. Amplitude Modulation and Demodulation
2. Frequency Modulation and Demodulation
3. Six diode sampler setup for DAM
4. Single Side band setup
5. Double side band setup
6. Automatic gain control setup
7. Mixer setup
8. Carrier recovery setup
9. Pulse width modulation setup
10. Pulse frequency modulation setup
11. Frequency modulation (VCO & PLL) setup
12. Design and implementation of AM with fc = 1MHz and fm = 1KHz
13. Design and implementation of frequency multiplier circuit
14. Design and implementation of carrier recovery circuit
15. Design and implementation of DSB-SC
16. Design and implementation of mixer
17. Design and implementation of PWM, PFM.

EC3702 RF and Microwave Engineering Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

Course Objectives:

1. The goal of this course is to introduce students to the concepts and principles of the advanced microwave engineering.
2. To study the characteristics of RKO and Gunn oscillator.
3. Measurement of frequency and wavelengths would be learnt by the student.
4. VSWR various TEES, MHD and Circulator would be understood by the student.
5. Radiation pattern would be learnt by the student for horn antenna.
6. To study the usage of hand held Vector Network Analyzer, Spectrum Analyzer, Advanced Microwave Integrated Circuits.

Course Outcomes:

1. Gain knowledge and understanding of microwave analysis methods.
2. Be able to apply analysis methods to determine circuit properties of passive/active microwave devices.
3. Analyze the characteristics of RKO and Gunn oscillator.
4. Measure the frequency and guided wavelength.
5. Estimate the VSWR for various loads and S-Matrix for various microwave devices.
6. Obtain the horn antenna radiation pattern.

LIST OF EXPERIMENTS:

1. Familiarization with waveguide components and usage of VSWR meter, slotted line, etc.

2. Measurement of guide wavelength and determination of frequency.

3. Measurement of detector constant _.

4. Measurement of directional coupler such as coupling, directivity, etc.

5. Measurement of radiation characteristics of horn antenna such as radiation patterns and gain.

6. Gunn oscillator measurements such as power versus frequency, I-V characteristics.

7. Klystron characteristics measurement.

8. Impedance measurement and attenuation measurement.

9. Measurement of S-parameters of waveguide T-junction.

10. Measurement of dielectric constant of a sample.

EC3703 Digital Signal Processing Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

Course Objectives:

1. Perform basic manipulation (Convolution, DFT, IDFT) of two signals using CCS.
2. Estimate power spectral densities using a variety of techniques using CCS.
3. Study the operation and performs of TMS320C64XX/TMS320C67XX fixed/floating point processor.
4. Usage of CODEC which is onboard of TMS320C64XX/TMS320C67XX fixed/floating point processor.
5. Configure TMS320C64XX/TMS320C67XX fixed/floating point processor as a function generator using its CODEC and its I/O

Course Outcomes:

1. Students will be familiarized with CCS kit with analog I/O and other peripherals.
2. Students have implemented basic manipulations (Convolution, DFT, IDFT) of two signals using CCS.
3. Students have used the DSK6713/6416 without CODEC as a Traffic light controller and with CODEC as a signal generator.
4. Students have designed and implementd
5. Students have implemented digital filters (FIR and IIR) using TMS320C6713 floating point processor

LIST OF EXPERIMENTS:

1. Familiarization with CCS kit with analog I/O and other peripherals.

2. FIR filter design

3. IIR filter design

4. Implementation for real time operation, testing with speech signal.

5. Use of MATLAB for filtering (FIR/IIR)

6. Use of SIMULINK

7. Design of a temperature control system including acquisition of signals.

EC3901 Seminar - II

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**1-0-1**

Scheme of Internal Exam	: 25 Marks
Credits	: 1

Course Objectives:
Objective of the project seminar is to actively involve the students in preparation of the final year project with regard to following components:

- Problem definition and specification
- Literature survey, familiarity with research journals
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of graphs, bar (activity) charts and analyzing the results.
- Presentation - oral and written.

The evaluation is purely internal and will be conducted as follows:

Preliminary Report on progress of the work and viva	05 marks
Final report	05 marks
Presentation and Defence before a departmental committee consisting of Head, a senior faculty and supervisor	15 marks

Rajiv Gandhi University of Knowledge Technologies

Basar, Nirmal – 504107

B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

III YEAR II SEMISTER

Code	**Subject**	**L-T**	**P**	**C**
EC3201	Digital communications	4	-	4
EC3202	Digital System design	4	-	4
EC3203	Microprocessors and Interfacing	4	-	4
CS3001	Object Oriented Programming	4	-	4
CS3204	Computer Networks	4	-	4
HS3201	Soft Skills-II	2	-	1
EC3801	Digital communications Lab	-	3	2
EC3802	Digital System design Lab	-	3	2
CS3601	Object Oriented Programming Lab	-	3	2
EC3000	Comprehensive Viva-I	1	-	1
EC3902	Seminar-III	1	-	1
	Total	**22**	**9**	**28**

EC3201 Digital Communications

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. To introduce the components of Digital communication systems.
2. To learn various digital pulse modulation techniques like PCM, DPCM,DM.
3. To learn digital carrier modulation techniques like FSK, M-ary PSK, M- ary QAM. And probability of error calculations in the presence of noise.
4. To revise the concept of random variables and random processes needed for the analysis of digital communication systems.
5. To learn the different source coding and channel coding schemes.
6. To learn the need for spreading a code and various spread spectrum techniques.

Course Outcomes:

At the end of this course Students will learn:

1. The basic building blocks of digital communication systems.
2. Analysis of Digital pulse modulation techniques.
3. Probability of error analysis for digital carrier modulation techniques like FSK, M-ary PSK, M- ary QAM in the presence of AWGN.
4. Basic Information theory concepts.
5. Multiple access techniques like TDMA, FDMA, CDMA.

UNIT-I: Introduction

Introduction to digital signals and systems, spectra and bandwidth. A-Dconversion and quantization. PCM, Log-PCM, DPCM, DM, ADPCM, and LPC for speech signals, timedivision multiplexing, digital hierarchy and standards, basebandtransmission.

UNIT-II: Modulation Techniques

Digital modulation and demodulation: binary and M-aryASK, FSK, GMSK, PSK, DPSK and their spectra, circuits and systems,carrier recovery, performance of digital modulation systems, dataregenerators and clock recovery, inter-symbol interference, equalizers.

UNIT-III: Random Processes

Detection of binary signals in presence of Gaussian noise, Maximumlikelihood receiver, Matched filter, Realization of matched filter, Errorprobability.

UNIT-IV: Information theory:

Elements of information theory, Source coding theorem, Discrete memory less channels, Channel capacity, Channel coding theorem,Information capacity theorem.

UNIT-V:Spread spectrum Techniques:

Pseudo noise sequences, A Notion of spread spectrum, DS-Spread Spectrum, Frequency hopping, synchronization, Jamming.

TEXT BOOKS:

1. A. Bruce Carlson, & Paul B. Crilly, ―Communication Systems – An Introduction to Signals & Noise in Electrical Communication‖, McGraw-Hill International Edition, 5th Edition, 2010.
2. Sam Shanmugam, ―Digital and Analog Communication Systems‖, John Wiley, 2005.

REFERENCES:

1. Bernard Sklar, ―Digital Communications‖, Prentice-Hall PTR, 2nd edition, 2001.
2. Simon Haykin, ―Communication Systems‖, Wiley-India edition, 3rd edition, 2010.
3. B.P. Lathi, & Zhi Ding, ―Modern Digital & Analog Communication Systems‖, Oxford University Press, International 4th edition, 2010.
4. Herbert Taub & Donald L Schilling, ―Principles of Communication Systems‖, Tata McGraw-Hill, 3rd Edition, 2009

EC3202 Digital System Design

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. Understands the design methodologies for combinational and sequential logic circuits.
2. Systems design using MSI and LSI Implementations.
3. Basic knowledge of Verilog HDL to design digital systems.
4. System design using ASM charts and Microprogrammed ASM charts.
5. Simulation and Synthesis for digital systems using the Verilog HDL language.

Course Outcomes:

1. Able to understand programmable logic designs and its implementation for the digital systems.
2. Able to analysis with all timing parameters for the digital systems
3. Able to write Verilog HDL code for advanced digital systems.
4. Able to design advanced digital system using ASM Chart.

Able to verify the design using simulation and synthesis tools

UNIT-I:INTRODUCTION

Introduction to VLSI design, Combinational circuit design, PLD, PAL, Review of Flip Flops, Timing Diagrams

UNIT-II:RTL CODING

Sequential circuit design, MSI implementation of sequential circuits, Design of sequential circuits using one hot controller, Verilog modeling of combinational circuits, Modeling of verilog sequential circuits, Modeling of verilog sequential circuits, RTL coding guidelines, Coding realization – complete realization, Coding realization – complete realization, Writing a test bench

UNIT-III:ASM CHARTS

System design using ASM Chart (BUS ARBITOR), Traffic Light Controller, Examples of System design using ASM Chart, DICE GAME, Micro programmer design

UNIT-IV:SIMULATION USING MODELSIM

Design flow of VLSI circuits, Simulation of combinational circuits, Simulation of combinational circuits, Analysis of waveforms using Modelsim, Analysis of waveforms using Modelsim, Modelsim simulation tool

UNIT-V:SYNTHESIS AND SYNPLIFY TOOLS

Synthesis tool, Synplify tool – schematic circuit diagram view, Technology view using Synplify tool, Synopsys tool and parallel cases, Xilinx place and route tool

REFERENCES

1. Jon F Wakerly, Digital Design: Principles and Practices, Prentice Hall.
2. Kevin Skahil, VHDL for programmable logic, Addison Wesley.
3. Zainalabedin Navabi, VHDL, analysis and modeling of digital systems, McGraw-Hill.
4. PLD, FPGA data sheets.

EC3203 Microprocessors & Interfacing

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

1. To examine the 8085 and 8086 microprocessors in terms of hardware/software and functions of signals generated/accepted.
2. To understand the 8086 architecture and its programming.
3. To understand the various input-output interfaces.
4. To understand memory interfacing, interrupts of 8086 and DMA controller.
5. To explore various communication interfaces.

Course Outcomes:

1. Able to differentiate architecture of 8085 and 8086 microprocessors.
2. Write an assembly language programming for different applications in 8086.
3. Able to interface peripherals like keyboard, display, ADC and DAC etc. to 8086.
4. Design an 8086 based microcomputer by interfacing memory and DMA.
5. Able to communicate through RS-232 and USART.
1.

UNIT I: 8085 and 8086 Architecture;

Introduction to 8085 Microprocessor, 8086 Architecture-Functional diagram. Register Organization, Memory Segmentation. Programming Mode!. Memory addresses. Physical memory organization. Architecture of 8086, signal descriptions of 8086- common function signals. Minimum and Maximum mode signals. Timing diagrams. Interrupts of 8086.

UNIT II: Instruction Set and Assembly Language Programming of 8086:

Instruction formats, addressing modes, instruction set, assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.

UNIT III: I/O Interface:

8255 PPI various modes of operation and interfacing to 8086. Interfacing keyboard, display, stepper motor interfacing, D/A and A/D converter.

UNIT IV: Interfacing with advanced devices:

Memory interfacing to 8086, Interrupt structure of 8086, Vector interrupt table, Interrupt service routine. Introduction to DOS and BIOS interrupts, Interfacing Interrupt Controller 8259 DMA Controller 8257 to 8086.

UNIT V: Communication Interface:
Serial communication standards, Serial data transfer schemes. 8251 USART architecture and interfacing. RS- 232. IEEE-4-88, Prototyping and trouble shooting.

TEXT BOOKS:

1. D. U. Hall. Micro processors and Interfacing, TMGH. 2'1 edition 2006.
2. Advanced Microprocessors and Peripherals - A. K. Ray and K.M. Bhurchandani, TMH, 2nd edition 2006.

REFERENCE BOOKS:

1. Micro Computer System 8086/8088 Family Architecture. Programming and Design - By Liu and GA Gibson, PHI, 2nd Ed.
2. The 8088 and 8086 Micro Processors – PHI, 4th Edition, 2003

CS3001 Object Oriented Programming though Java

Externals: 60Marks **(L-T)-P-C**
Internals: 40Marks **4-0-4**

Course Objectives:

- To be able to differentiate between structures oriented programming and object oriented programming.
- To be able to use object oriented programming language like Java and associated libraries to develop object oriented programs.
- To Able to understand and apply various object oriented features like inheritance, data abstraction, encapsulation and polymorphism to solve various computing problems using Java language.
- To be able to apply concepts of operator overloading, constructors and destructors.
- To be able to apply exception handling and use built-in classes

Course Outcomes:

CO 1: Learning principals of object oriented programming paradigm in Java including classes, Objects, Methods, Abstraction, encapsulation, inheritance and polymorphism.

CO 2: Understand fundamentals of programming such as variables, conditional and iterative execution, methods, packages & interfaces etc.

CO 3: Learning the concept of inheritance to create new classes from existing one & Design the classes needed given a problem specification;

CO 4: Learning how to detect exceptions and to handle strings & Implement the designed classes using the object oriented programming language

CO 5: Learn how to test, verify, and debug object-oriented programs; and Learning about multithreading and multitasking.

CO 6: Creating and Demonstrating Applications using the concept of OOPS, event handling, JDBC Connectivity used in GUI with Java.

UNIT-1:

Introduction to OOPS: Paradigms of Programming Languages, Basic concepts of Object Oriented Programming, Differences between Procedure Oriented Programming and Object Oriented Programming, Objects and Classes, Data abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic binding, Message communication, Benefits of OOP , Application of

OOPs.

Java : History, Java features, Java Environment, JDK, API.

Introduction to Java : Types of java program, Creating and Executing a Java program, Java Tokens, Keywords, Character set, Identifiers, Literals, Separator, Java Virtual Machine (JVM), Command Line Arguments, Comments in Java program.

UNIT -2:

Elements: Constants, Variables, Data types, Scope of variables, Type casting, Operators: Arithmetic, Logical, Bit wise operator, Increment and Decrement, Relational, Assignment, Conditional, Special operator, Expressions – Evaluation of Expressions
Decision making and Branching: Simple if statement, if, else statement, Nesting if, else, else if Ladder, switch statement, Decision making and Looping: While loop, do, While loop, for loop, break, labelled loop, continue Statement.-, Simple programs

Arrays: One Dimensional Array, Creating an array, Array processing, Multidimensional Array, Vectors, Wrapper classes, Simple programs

UNIT-3:

Strings: String Array, String Methods, String Buffer Class, Simple programs

Class and objects: Defining a class, Methods, Creating objects, Accessing class members, Constructors, Method overloading, Static members, Nesting of Methods, this keyword, Command line input, Simple programs
Inheritance: Defining a subclass, Deriving a sub class, Single Inheritance, Multilevel Inheritance, Hierarchical Inheritance, Overriding methods, Final variables and methods, Final classes, Finalizer methods, Abstract methods and classes, Visibility Control: Public access, Private access, friend, protected. Interfaces: Multiple Inheritance, Defining interface, Extending interface, Implementing Interface, Accessing interface variables, Simple programs

UNIT- 4:

Packages: Java API Packages, System Packages, Naming Conventions, Creating & Accessing a Package, Adding Class to a Package, Hiding Classes, Programs
Applets: Introduction, Applet Life cycle, Creating & Executing an Applet, Applet tags in HTML, Parameter tag, Aligning the display, Graphics Class: Drawing and filling lines, Rectangles, Polygon, Circles, Arcs, Line Graphs, Drawing Bar charts, Programs
AWT Components and Even Handlers: Abstract window tool kit, Event Handlers, Event Listeners, AWT Controls and Event Handling: Labels, TextComponent, ActionEvent, Buttons, CheckBoxes, ItemEvent, Choice, Scrollbars, Layout Managers- Input Events, Menus, Programs

UNIT-5:

Exception Handling: Limitations of Error handling, Advantages of Exception Handling, Types of Errors, Basics of Exception Handling, try blocks, throwing an exception, catching an exception, finally statement
Multithreading: Creating Threads, Life of a Thread, Defining & Running Thread, Thread Methods, Thread Priority, Synchronization, Implementing runnable interface, Thread Scheduling.
I/O Streams: File, Streams, Advantages, The stream classes, Byte streams, Character streams.

JDBC, ODBC Drivers, JDBC ODBC Bridges, Seven Steps to JDBC, Importing java SQL Packages, Loading & Registering the drivers, Establishing connection. Creating &Executing the statement.

Suggested References:

1. Programming with Java - E. Balagurusamy
2. Java the complete reference, 7th editon, Herbert schildt, TMH.
3. Understanding OOP with Java, updated edition, T. Budd, pearsoneduction.
4. Object oriented Programming in Java - Dr. G.Thampi
5. Let us Java – Yashavant Kanetkar - BPB Publications, New Delhi - First Edition 2012

An Introduction to Oops with Java - C Thomas WU - TataMc-Graw Hill, 4th Edition

CS3204 **Computer Networks**

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-4**

Course Objectives:

- To introduce the fundamental various types of computer networks.
- To demonstrate the TCP/IP and OSI models with merits and demerits.
- To introduce UDP and TCP Models.

Course Outcomes:

- Understand computer network basics, network architecture, TCP/IP and OSI reference models.
- Identify and understand various techniques and modes of transmission.
- Describe data link protocols, multi-channel access protocols and IEEE 802 standards for LAN.
- Describe routing and congestion in network layer with routing algorithms and classify IPV4 addressing scheme.
- Discuss the elements and protocols of transport layer.
- Analyze and understand the various protocols such as FTP, HTTP, Telnet, DNS, SSH, and SMTP.

UNIT - I:

Overview of the Internet: Protocol, Layering Scenario, TCP/IP Protocol Suite: The OSI Model, Internet history standards and administration; Comparioson of the OSI and TCP/IP reference model.

Physical Layer: Guided transmission media, wireless transmission media.

Data Link Layer: design issues, CRC codes, Elementary Data Link Layer Protocols, sliding window protocol.

UNIT - II:

Multi Access Protocols: ALOHA, CSMA, Collision free protocols, Ethernet- Physical Layer, Ethernet Mac Sub layer, data link layer switching & use of bridges, learning bridges, spanning tree bridges, repeaters, hubs, bridges, switches, routers and gateways.

UNIT-III:

Network Layer: Network Layer Design issues, store and forward packet switching connection less and connection oriented networks-routing alhorithms-optimality principle, shortest path, flooding, Distance Vector Routing, Control to Infinity Problem, Hierarchical Routing, Congestion control algorithms, admission control.

UNIT-IV:

Internetworking: Tunneling, Internetwork Routing, Packet fragmentation, IPv4, IPv6 Protocol, IP addresses, CIDR, IMCP, ARP, RARP, DHCP.
Transport Layer: Services provided to the upper layers elements of transport protocol-addressing connection establishment, connection release, Connection Release, Crash Recovery.

UNIT-V:
The Internet Transport Protocols: UDP-RPC, Real Time Transport Protocols, The Internet Transport Protocols- Introduction to TCP, The TCP Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Connection Management Modeling, The TCP Sliding Window, The TCP Congestion Control, The future of TCP.
Application Layer: Introduction, providing services, Applications layer paradigms, Client server model, Standard client-server application-HTTP, FTP, electronic mail, TELNET, DNS, SSH

Suggested References:

1. Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.
2. Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.
3. An Engineering Approach to Computer Networks - S. Keshav, 2nd Edition, Pearson Edication.
4. Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.
5. Introduction to Computer Networks and Cyber Security, Chwan-Hwa (John) Wu, J. David Irwin, CRC Press.
6. Computer Networks, L. L. Peterson and B. S. Davie, 4th edition, ELSEVIER.
7. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.

HS3201 **Soft Skills II**

Externals: 60 Marks **L-T-P-C***

Internals: 40 Marks **2-0-0-1**

Course Objectives:

1. To enable students speak effectively in formal and informal situations
2. To equip the students with necessary writing skills in order to face the corporate world
3. To strengthen the writing skills of the students and help them in documentation
4. To enable students sharpen their communication skills towards writing a persuasive resume and effective job application letters
5. To equip students with pre-presentation steps, to understand the structure of a good presentation, and devise various techniques for delivering a successful presentation
6. To make students understand the importance of team work and group presentations and group discussions

Course Outcomes:

Students will be able:

1. communicate effectively in formal and informal situations
2. understand the structure and mechanics of writing resumes, reports, documents and e-mails
3. present effectively in academic and professional contexts
4. develop communication in writing for a variety of purposes
5. identify areas of evaluation in Group Discussions conducted by organizations as part of the selection procedure
6. overcome stage fear and tackle questions

UNIT-I

Activities on Fundamentals of Inter-personal Communication
Starting a conversation - responding appropriately and relevantly - using the right body language-Role Play in different situations & Discourse Skills using visuals.

UNIT-II

Activities on Reading Comprehension

General Vs Local comprehension- reading for facts- guessing meanings from context- scanning- skimming- inferring meaning- critical reading - effective googling.

UNIT-III

Activities on Writing Skills

Structure and presentation of different types of writing- Resume writing/ e-correspondence/ Technical report writing- planning for writing - improving one's writing.

UNIT-IV

Activities on Presentation Skills

Oral presentations (individual and group) through JAM sessions/seminars/PPTs and written presentations

UNIT-V

Activities on Group Discussion and Interview Skills - Dynamics of group discussion- intervention-summarizing-modulation of voice-body language-relevance-fluency and organization of ideas and rubrics for evaluation- Concept and process-pre-interview planning-opening strategies-answering strategies-interview through tele-conference & video-conferencing - Mock Interviews.

Suggested References:

1. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press 2009.

2. Advanced Communication Skills Laboratory Manual by Sudha Rani, D, Pearson Education 2011.

3. Technical Communication by Paul V. Anderson , 2007. Cengage Learning pvt. Ltd. New Delhi.

4. Business and Professional Communication: Keys for Workplace Excellence, Kelly M. Quintanilla & Shawn T. Wahl. Sage South Asia Edition. Sage Publications, 2011.

5. The Basics of Communication: A Relational Prespective, Stev Duck & David T. Mc Mahan. Sage South Asia Edition. Sage Publications, 2012.

6. English Vocabulary in Use series, Cambridge University Press 2008.

7. Handbook for Technical Communication by David A. McMurrey & Joanne Buckley, 2012. Cengage Learning.

9. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.

10. Handbook for Technical Writing by David A McMurrey & Joanne Buckely CENGAGE Learning 2008.

EC3801 Digital Communications Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

Course Objectives:

1. To design and implement the analog to digital conversion circuit.
2. To design and implement the modulation and demodulation circuits used in digital communication systems.
3. To learn about multiplexing and de-multiplexing of data.

Course Outcomes:

After completing this lab, students will learn:

1. How to design basic digital communication system components like PCM, ASK, PSK, BPSK, QPSK modulators and demodulators, error correction circuits.
2. Multiplexing and de-multiplexing of digital signals.

LIST OF EXPERIMENTS:

2. Verification of sampling theorem.
3. Quantizer design.
4. PCM implementation.
5. PN sequence generation circuit.
6. ASK modulator and demodulator circuits.
7. FSK modulator and demodulator circuits.
8. BPSK modulator and demodulator circuits.
9. QPSK modulator and demodulator circuits.
10. Multiplexing and de-multiplexing of the digital signals.
11. Line coder setup.
12. Optical fiber communication setup.
13. Decoding of corrupted repetition code.

EC3802 Digital System Design Lab

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **0-3-2**

Course Objective:

1. Familiarize with VLSI CAD tools like Xilinx14.4 and Mentor Graphics tool.
2. Gives Basic concepts of Verilog HDL code to write a code for digital circuits.
3. To have hands on experience to design digital circuits, simulate and synthesis the design with Xilinx 14.4 VLSI CAD tool with timing diagrams and RTL diagrams.
4. To have hands on experience for transistor level design and simulate it with transient and dc analysis using mentor Graphics tool.
5. FPGA implantation of the Verilog code written in the VLSI CAD tool.

Course Outcomes:

1. Able to write a Verilog HDL code for the digital systems.
2. Able to use the VLSI CAD tools to design digital systems and get synthesis the design to get RTL level diagram.
3. Able to simulate the digital system to check the functionality with the timing diagrams.
4. Able to do transient and dc analysis of the CMOS Inverter, Logic gates and analog circuits.
5. Able to do FPGA Implementation of the combinational and sequential circuits.

LIST OF EXPERIMENTS:

1. Familiarization with Xilinx14.4 tool.
2. Simulate and Synthesis of all basis gates.
3. Simulate and synthesis of multiplexers, decoders and code converters.
4. Simulate and synthesis of all flipflops.
5. Simulate and synthesis of Universal shift register.
6. Simulate and synthesis of the binary counter, MOD counters.
7. FPGA implementation of basic gates and binary counter.
8. Familiarization of the mentor Graphic tool for transistor level design.
9. Design and synthesis of a CMOS amplifier
10. Transient and DC analysis of CMOS inverter.
11. Transient, DC and power analysis of the NAND and NOR gates using CMOS implementation.
12. Transient, DC and power analysis of the XOR gates using NAND gates cells.
13. Transient, DC and power analysis of the 2x1 MUX using NAND gates cells.

CS3601 OBJECTED ORIENTED PROGRAMMING LAB

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **0-0-3-2**

Course Objectives:

- To be able to apply an object oriented approach to programming and identify potential benefits of object-oriented programming over other approaches.
- To be able to reuse the code and write the classes which work like built-in types.
- To be able to design applications which are easier to debug, maintain and extend.
- To be able to apply object-oriented concepts in real world applications.

Course Outcomes:

- Be able to analyze and design a computer program to solve real world problems based on object-oriented principles.
- Be able to write simple GUI interfaces for a computer program to interact with users, and to understand the event-based GUI handling principles.
- A competence to design, write, compile, test and execute straightforward programs using a high level language.
- Demonstrate the ability to employ various types of selection constructs in a Java program. Be able to employ a hierarchy of Java classes to provide a solution to a given set of requirements.
- Become familiar with the fundamentals and to acquire programming skills in the Java language.

Experiments:

1. A program to illustrate the concept of class with constructors, methods and overloading.
2. A program to illustrate the concept of inheritance and dynamic polymorphism.
3. A program to illustrate the usage of abstract class.
4. A program to illustrate multithreading.
5. A program to illustrate thread synchronization.
6. A program to illustrate Exception handling.
7. A program to illustrate user-defined Exceptions
8. A program to demonstrate use of User-defined Packages.
9. A program using String Tokenize.
10. A program using Linked list class
11. A program using Tree Set class
12. A program using Hash Set and Iterator classes
13. A program using Map classes.
14. A program using Enumeration and Comparator interfaces.
15. A program using File and Filename Filter
16. A program to illustrate the usage of Byte and Character I/O streams.
17. A program to illustrate the usage of Serialization.
18. Program using Data class.\
19. An application involving GUI with different controls, menus and event handling.
20. A program to implement an applet.

For the detailed list of programs refer the lab manual.

Note: Any experiment according to the syllabus of CS3001 can be substituted

EC3000	**Comprehensive Viva-I**	
Externals: 60Marks		**(L-T)-P-C**
Internals: 40Marks		**1-0-1**

EC3902 Seminar - III

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **1-0-1**

Scheme of Internal Exam : 25 Marks
Credits : 1

Course Objectives:
Objective of the project seminar is to actively involve the students in preparation of the final year project with regard to following components:

- Problem definition and specification
- Literature survey, familiarity with research journals
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of graphs, bar (activity) charts and analyzing the results.
- Presentation - oral and written.

The evaluation is purely internal and will be conducted as follows:

Preliminary Report on progress of the work and viva	05 marks
Final report	05 marks
Presentation and Defence before a departmental committee consisting of Head, a senior faculty and supervisor	15 marks

Rajiv Gandhi University of Knowledge and Technology

Basar, Mudhole, Adilabad – 504107

B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

IV YEAR I SEMISTER

Code	Subject	L-T	P	C
EC3900	Internship			6
EC44XX	Elective-I	4	-	3
EC44XX	Elective-II	4	-	3
EC44XX	Elective-III	4	-	3
EC44XX	Elective-IV	4	-	3
	Free Elective-I	4	-	3
EC4701	Microprocessor and microcontroller Lab	-	3	2
EC4702	VLSI Lab	-	3	2
	Total	**20**	**6**	**25**

List of Electives:

Elective-I	EC4401	Wireless Communications
Elective-I	EC4402	Coding Theory
Elective-I	EC4403	Satellite Communications
Elective-I	EC4404	Optical Communications
Elective-I	EC4405	Radar Systems
Elective-II	EC4411	Real Time Operating Systems
Elective-II	EC4412	IoT and Applications
Elective-II	EC4413	Embedded Systems
Elective-II	EC4414	Detection and estimation theory
Elective-III	EC4421	Analog VLSI and Mixed Signal Design
Elective-III	EC4422	Analog IC Design
Elective-III	EC4423	CAD of VLSI circuits
Elective-III	EC4424	RF Integrated Circuits
Elective-III	EC4425	Adhoc Wireless Sensor Networks
Elective-III	EC4426	Electronic Measurements and Instrumentation
Elective-IV	EC4431	Digital Image Processing
Elective-IV	EC4432	Multimedia Communication
Elective-IV	EC4433	DSP Processors Architecture
Elective-IV	EC4434	Antennas and Wave Propagation
Elective-IV	EC4435	Biomedical Signal Processing
Free Elective	EC4502	Data Mining
Free Elective	EC4503	Machine Learning Techniques

EC4401 Wireless Communications

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course objectives:

- To provide the students with the fundamental theoretical and practical concepts of wireless communication
- To equip the students with various kinds of wireless networks and its operations.
- To prepare the students to understand the concept of frequency reuse and be able to apply it in the design of mobile cellular system

- To prepare the students to understand various multiple access techniques that are used in wireless communications
- To train the students to understand the basic concepts of OFDM and MIMO.

Course outcomes:

- On successful completion of this course, the students should be able to:

- Select appropriate value of C/I to design the Antenna system
- Analyze the characteristics of different setups for the wireless communication using new models for the coverage improvement.
- Select different technologies to solve numerical problems using multiple access technique.
- Demonstrate the technical aspects of diversity for wireless communication.
- Understand the basic PAPR problem in OFDM and understanding basic concepts in SIMO.

UNIT - I

Basic Cellular system and its operation: frequency reuse, channel assignment strategies, Handoffprocess, factors influencing handoffs, handoffs in different Generations, Interference and system capacity, Crosstalk, Enhancing capacity and cell coverage, Trunked radio system, grade of service as per Erlang's B system.

UNIT – II

Propagation models: Free space propagation model, three basic propagation mechanisms, practical linkbudget design using path loss models, outdoor propagation models: Ground reflection (2-ray) Model, log normal shadowing, Okumura model, Hata model and indoor propagation model. Rayleigh fading, BER in Rayleigh fading channel with BPSK transmission,doppler spread, rms delay spread, Coherence time and Coherence bandwidth of wireless channel.

UNIT – III

Basic equalizers: LS, MMSE estimators for channel, Multiple Access Techniques: FDMA, TDMA, CDMA, RAKE receiver, SDMA.

UNIT – IV

SIMO: Diversity, SIMO (multiple receive antennas) model, maximal ratio combining (MRC) receiver, BER with MRC (high SNR approximation), diversity order.

UNIT – V

OFDM: Multicarrier basics, OFDM transmitter and receiver blocks, cyclic prefix in OFDM, PAPR problem in OFDM, SC-FDMA transmitter and receiver blocks.

Text Books:

Theodore.S. Rappaport, “Wireless Communications: Principles and Practice”, 2/e, Pearson Education, 2010

Aditya K Jagannatham, “Principles of Modern Wireless Communication Systems”, Mc-Graw Hill

Suggested Reading:

David Tse and Pramod Viswanath, “Fundamentals of Wireless Communications”,Cambridge University Press.

EC4402 Coding Theory

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To study the importance of channel coding techniques in digital communications.
- To learn the mathematical structure of various codes
- To learn the algorithms for various codes
- To study the various application of codes.
- To acquire the knowledge of measurement of information

Course Outcomes:

- At the end of this course Students will be able to
- Understand principles of channel Coding techniques.
- Analyze the performance of different codes.
- Design various codes like block codes, cyclic codes, convolution codes, turbo codes etc.
- Generate different codes.
- Estimate the information content and errors

UNIT-I

Coding for Reliable Digital Transmission and Storage: Introduction, Types of codes, Types of errors, Channels models, Modulation and coding, channel coding Theorem, Channel coding gain.

UNIT-II

Linear Block codes: Introduction, encoding, syndrome decoding, error-detecting and correcting

capabilities, Maximum likelihood decoding.Cyclic codes: Description, encoding and syndrome decoding.

UNIT- III

Galois Fields: Groups, Fields, Binary arithmetic, Construction of Galois Fields GF(2m), Basic properties of Galois Fields. RS codes: Introduction, encoding and decoding (Berlekamp-Massey algorithm).

UNIT- IV

Convolution codes: Introduction, Encoding, State diagram, Trellis diagram, Decoding - Maximum-Likelihood decoding, soft decision and hard decision decoding, Viterbi algorithm.

UNIT- V

Turbo codes: Concatenation, Types of Concatenation, interleaving, types of interleavers, Turbo codes: Introduction, encoding and decoding (BCJR Algorithm).

Text books:

Shulin and Daniel J. Costello, Jr. “Error Control Coding,” 2/e, Pearson, 2011.

L.H.Charles LEE “Error control block codes for Communication Engineers”, Artech, 2000.

Suggested readings:

Simon Haykin, “Communication Systems”, 4/e, Wiley, 2000.

K Sam Shanmugum, “Digital and Analog Communication Systems”, Wiley, 2005.

EC4403 Satellite Communications

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To prepare the student to excel in basic knowledge of satellite communication principles.
- To provide students with solid foundation in orbital mechanics and launches for the satellite communication

- To train the students with the basic knowledge of link design of satellite with a design examples.
- To provide the better understanding of multiple access systems and earth station technology.
- To prepare the students with knowledge in satellite navigation and GPS and satellite packet communication

Course Outcomes:

- At the end of this course Students will be able to
- Explain, basic concepts and frequency allocations for satellite communications.
- Describe the orbital mechanics, launch vehicles and launchers.
- Design satellite links for specified C/N.
- Visualize satellites sub systems like telemetry, tracking, command and monitoring power systems etc.,
- Explain the different multiple access systems and their need in satellite communications and GPS Receivers,.

UNIT-I: Communication Satellite Orbit and Description

A Brief history of satellite Communication, satellite Frequency Bands, Satellite Systems, Applications, Orbital Period and Velocity, effects of orbital Inclination, Azimuth and Elevation, Coverage angle and slant Range, Eclipse, Orbital Perturbations,Placement of a Satellite in a Geo-Stationary orbit.

UNIT-II: Satellite Sub-Systems

Attitude and Orbit Control system, TT&C subsystem, Attitude Control subsystem,Power systems, Communication subsystems, Satellite Antenna Equipment.Satellite Link: Basic Transmission Theory, System Noise Temperature and G/T ratio, Basic LinkAnalysis, Interference Analysis, Design of satellite Links for a specified C/N, (With and without frequency Re-use), Link Budget

UNIT-III: Propagation Effects

Introduction, Atmospheric Absorption, Cloud Attenuation, Tropospheric and Ionospeheric Scintillation and Low angle fading, Rain induced attenuation, rain induced cross polarization interference. Multiple Access : Frequency Division Multiple Access (FDMA) -Intermodulation, Calculation of C/N, Time Division Multiple Access (TDMA) -Frame Structure, Burst Structure, Satellite switched TDMA, On-board Processing, Demand Assignment Multiple Access (DAMA) –Typesof Demand Assignment, Characteristics, CDMA Spread Spectrum Transmission and Reception.

UNIT-IV: Earth Station Technology

Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface,Power Test Methods, Lower Orbit Considerations. Satellite Navigation and Global Positioning Systems:Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers, GPS C/A Code Accuracy, Differential GPS.

UNIT-V: Satellite Packet Communications

Message Transmission by FDMA: M/G/1 Queue, Message Transmission by TDMA, PURE ALOHA-Satellite Packet Switching, Slotted Aloha, Packet Reservation, Tree Algorithm.

TEXT BOOKS:

1. Satellite Communications –Timothy Pratt, Charles Bostian, Jeremy Allnutt, 2ndEdition, 2003,john Wiley & Sons.

2. Satellite Communications Engineering –Wilbur, L. Pritchand, Robert A. Nelson and Heuri G.Suyderhoud, 2ndEd., Pearson Publications.

3. Digital Satellite Communications-Tri.T.Ha, 2ndEdition, 1990, Mc.Graw Hill.

REFERENCES:

1. Satellite Communications-Dennis Roddy, 2ndEdition, 1996, McGraw Hill.

2. Satellite Communications: Design Principles –M. Richcharia, 2ndEd., BSP, 2003.

3.Digital Satellite Communications –Tri. T. Ha, 2ndEd., MGH, 1990.

4. Fundamentals of Satellite Communications –K. N. Raja Rao, PHI, 2004.

EC4404 OPTICAL COMMUNICATIONS

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To realize the significance of optical fiber communications.
- To understand the construction and characteristics of optical fiber cable.
- To develop the knowledge of optical signal sources and power launching.
- To identify and understand the operation of various optical detectors.
- To under the design of optical systems and WDM.

Course Outcomes:

- At the end of this course Students will learn:

- Describe and classify the different modulation formats and optical components
- Understand and analyze the constructional parameters of optical fibers.
- Estimate the losses due to attenuation, absorption, scattering and bending.
- Analyze the optical sources and detectors and derive the expression for their efficiency
- Compare various optical detectors and choose suitable one for different applications.
- Design an optical fiber link

UNIT-I: Overview of optical fiber communication

Historical development, The general system, advantages of optical fiber communications.Optical fiber wave guides- Introduction, Ray theory transmission, Total Internal Reflection,Acceptance angle, Numerical Aperture, Skew rays. Cylindrical fibers- Modes, Vnumber, Modecoupling, Step Index fibers, Graded Index fibers.Single mode fibers - Cut off wavelength, Mode Field Diameter, Effective Refractive Index. [2]. Fiber materials — Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers.

UNIT-II: Signal distortion in optical fibers

Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity determination, Group delay, Types of Dispersion – Material dispersion, Wave-guide dispersion, Polarization mode dispersion, Intermodal dispersion. Pulse broadening. Optical fiber Connectors- Connector types, Single mode fiber connectors, Connector return loss.

UNIT-III: Fiber Splicing

Splicing techniques, Splicing single mode fibers. Fiber alignment and joint loss- Multimode fiber joints, single mode fiber joints,. Optical sources- LEDs, Structures, Materials, Quantumefficiency, Power, Modulation, Power bandwidth product. Injection Laser Diodes- Modes, Threshold conditions, External quantum efficiency,Laser diode rate equations,Resonant frequencies. Reliability of LED&ILD.Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling.

UNIT-IV: Optical detectors

Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparision of Photodetectors. Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital

Receiverperformance, Probability of error, Quantum limit, Analog receivers.

UNIT-V: Optical system design

Considerations, Component choice, Multiplexing. Point-to- point links, System considerations, Link power budget with examples. Overall fiber dispersion in Multi mode and Single mode fibers, Rise time budget with examples. Transmission distance, Line coding in Optical links, WDM, Necessity , Principles, Types of WDM, Measurement of Attenuation and Dispersion, Eye pattern.

TEXT BOOKS:

1. Optical Fiber Communications – Gerd Keiser, Tata Mc Graw-Hill International edition,4th Edition,2008.

2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.

REFERENCES:

1. Fiber Optic Communications – D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.

2. Text Book on Optical Fibre Communication and its Applications – S.C.Gupta, PHI, 2005.

3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Ediition, 2004.

4. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.

EC4405 **RADAR SYSTEMS**

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To learn working principle of Radar Operating frequencies and derive Radar Range Equation,
- To understand the basic concepts of different types of Radars for surveillance & Tracking.
- To learn functioning of MTI radar and its performance limitations.
- To get acquainted with the working principles of CW radar, FM-CW radar.
- To understand concept of a Matched Filter in Radar Receivers gain knowledge of different receiver blocks and understand receiver functioning

Course Outcomes:

- At the end of this course Students will learn:
- Distinguish between   thefunctioning of CW FM-CW and MTI radars,
- Apply Doppler principle to radars and hence detect moving targets.
- Distinguish between Sequential Lobing, Conical Scan, Monopulse type 0f Tracking Radars, specify their requirements and compare their characteristic features.
- Derive the matched filter response characteristics for radar applications and account for correlation receivers; to distinguish between different radar displays and duplexers.
- Account for the electronic scanning principle and implement the same through phased array antennas, knowing their requirements and utilities.

UNIT-I: Basics of Radar

Introduction, Maximum Unambiguous Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Predictionof Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Related Problems. Radar Equation: SNR, Envelope Detector-False AlarmTime and Probability, Integration of Radar Pulses,Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Related Problems.

UNIT-II: CW and Frequency Modulated RadarDoppler Effect,

CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Related Problems.FM-CW Radar: FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.

UNIT-III: MTI and Pulse Doppler Radar

Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar –Amplitude Comparison Monopulse (one- and two- coordinates), Angular Accuracy, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT-IV: Detection of Radar Signals in Noise

Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non- matched Filters, Matched Filter with Non-white Noise.

UNIT-V: Radar Receivers

Noise Figure and Noise Temperature, Displays – types, Introduction to Phased Array Antennas –Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Applications, Advantages and Limitations.ElectronicWarfare : Introduction to ESM, ECM and ECCM systems.

TEXT BOOKS:

1.Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2 nd Edition, Tata McGraw-Hill, 2007.

REFERENCES:

1. Introduction to Radar Systems – Merrill I. Skolnik, 3 rd Edition Tata McGraw-Hill, 2001.

2. Radar: Principles, Technology, Applications-Byron Edde, Pearson Education, 2004.

3. Principles of Modern Radar: Basic Principles-Mark A. Richards, James A. Scheer, William A. Holm, Yesdee,2013.

4. ‘Radar Hand Book ‘ Ed. By M.I Skolnik, 2 nd Edition, Tata McGraw Hill.

5. ‘Understanding Radar Systems’ by Simon Kinsley and Shaun Quegan, Scitech Publishing, McGraw-Hill.

EC4411 REAL TIME OPERATING SYSTEMS

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To understand the need of real time operating system.
- To learn the basic concepts of inter process communication (IPC).
- To analyze various scheduling algorithms related to RTOS.
- To introduce the elementary concepts of Vx works.
- To study the basic concepts of UNIX operating system.

Course Outcomes:

- At the end of this course Students will learn:
- 1.Understand Real-time operating system requirements and applications.
- Categorize different scheduling approaches for real time scheduler.

- Compare different real time systems.
- Analyze a module and understand design issues.
- Develop a real time embedded system module.

UNIT-I:

Introduction to Real Time Systems Structures of Operating System (Monolithic, Microkernel, Layered, Exo-kernel and Hybrid kernel structures), Operating system objectives and functions, Virtual Computers, Interaction of OS and Hardware architecture, Evolution of operating systems, Batch, multi programming. Multitasking, Multiuser, parallel, distributed and real-time OS.

UNIT-II:

Process Management of OS/RTOS Hard versus Soft Real-Time System: Jobs and Processors, release time, deadlines, and timing constraints, hard and soft timing constraints, hard real-time systems. Uniprocessor Scheduling: Types of scheduling, scheduling algorithms: FCFS, SJF, Priority, Round Robin, UNIX Multi-level feedback queue scheduling, Thread scheduling, Multiprocessor scheduling concept, Real Time scheduling concept.

UNIT-III:

Real Time Operating System Concepts Foreground and Background Systems, Shared Resource, Critical section of a Code, Multi-Tasking, Task, Context switch, Kernel, Scheduler, Preemptive and non-preemptive kernel, Inter Task Communication: Message Mailboxes, Message queues or pipes and Event flags, Semaphores, Interrupts

UNIT-IV:

Introduction to Vx works/UNIX OS Elementary Concepts of Vx Works: Multitasking, Task State Transition, Task Control- Task Creation and Activation, Task Stack, Task Names and IDs, Task Options, Task Information, Task Deletion and Deletion Safety. Fundamental Concepts of UNIX Operating Systems UNIX Kernel – File system, Concepts of – Process, Concurrent Execution & Interrupts. Process Management – forks & execution. Basic level Programming with system calls, Shell programming and filters.

UNIT-V:

Linux development process Types of Host /Target Development and debug setup, Generic Architecture of an Embedded Linux System, System start up, Types of Boot configurations, System Memory Layout, Development Tools: Project Workspace, IDE, GNCC cross platform, selecting and configuring kernel, setting up boot loader.

TEXT BOOKS:

Tanenbaum,“Modern Operating Systems,” 4/e, Pearson Edition, 2014.

Jane W.S.Liu, Real Time Systems, Pearson Education, Asia, 2001. REFERENCES: 1. Jean J Labrosse,“Embedded Systems Building Blocks Complete and Ready-to-use Modules in C” ,2/e, CRC Press ,1999. 2. Karim Yaghmour, Jon Masters, Gilad Ben-Yesset, Philippe Gerum, “Building Embedded Linux Systems”, O’Reilly Media, 2008.

Wind River Systems, “VxWorks Programmers Guide 5.5”, Wind River Systems Inc.2002.

EC4412 INTERNET OF THINGS & APPLICATIONS

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**4-0-3**

Course Objectives:

- To provide an overview of Internet of Things, building blocks of IoT and the real-world applications
- To make understand of differences in M2M, WSN with reference to Iot.
- To make the students to learn Python language in IoT context.
- To introduce Rasberry Pi device, its interfaces and Django Framework.

- To make the students to build IoT systems.

Course Outcomes:

At the end of this course Students will learn:

- Understand the terminology, enabling technologies and applications of IoT
- Learn the concept of M2M (machine to machine) and describe the differences between
- M2M and IoT.
- Understand the basics of Python Language which is used in many IoT devices.
- Describe the steps involved in IoT system design methodology.
- Design simple IoTsystemsusing the understanding of the Rasberry Pi board and interfacing sensors and actuators with Rasberry Pi

UNIT-I: Introduction & Concepts

Introduction & Concepts: Introduction to Internet of Things- Definitions & Characteristics of IoT, Physical Design of IOT-Things in IoT, IoT Protocols, Logical Design of IOT-IoT FunctionalBlocks, IoT Communication Models, IoT Communication APIs, IOT Enabling Technologies-Wireless Sensor Networks, Cloud Computing, Big Data Analytics,CommunicationProtocols,Embedded Systems, IOT Levels & Deployment Templates.

UNIT-II: Domain Specific IoTs

IoT applications for Home Automation, Cities, Environment, Energy,Retail, Logistics,

Agriculture, Industry, health and LifestyleIoT and M2M – Introduction, M2M, Differences between IoT and M2M, Software DefinedNetworking, Network Function Virtualization.

UNIT-III: Introduction to Python

Motivation for using Python for designing IoT systems, Language features of Python, Data types- Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, Data Structures: Control of flow-if, for, while, range, break/continue, pass, functions, modules, packaging, file handling,data/time operations, classes, Exception handling, Python packages of Interest for IoT - JSON, XML, HTTPLib, URLLib, SMTPLib

UNIT-IV: IoT Platforms Design Methodology

Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, ProcessSpecification, Domain Model Specification, Information Model Specification, Service

Specifications, IoT Level Specification, Functional View Specification, Operational View

Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.

UNIT-V: IoT Physical Devices and End Points

Basic building blocks of an IoT device, Rasberry Pi-About theRasberry Pi board, Rasberry Pi interfaces-Serial, SPI,I2C, Other IoT Devices- pcDuino, BeagleBone Black, CubieboardIoT Physical Servers and Cloud Offerings- Introduction to cloud storage models and CommunicationAPIs, WAMP-AutoBahn for IoT, Xivelycloud for IoT Python Web Application Framework: Django Framework-Roles of Model, Template and View.

TEXT BOOKS:

1. ArshdeepBahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach,

Universities Press, 2015.

REFERENCES:

1. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting

Everything", 1 st Edition, Apress Publications, 2013

2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD),

2014.

EC4413 EMBEDDED SYSTEMS

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**4-0-3**

Course Objectives:

- Understand the basics of an embedded system.
- Program an embedded system.
- To learn the design process of embedded system applications.
- To understands the RTOS and inter-process communication.
- To understand different communication interfaces.

Course Outcomes:

- At the end of this course Students will learn:

- Understand and design the embedded systems
- Learn the basics of OS and RTOS.
- Understand types of memory and interfacing to external world.
- Understand embedded firmware design approaches.
- Understand the interfacing of communication devices.

Syllabus:

UNIT-I: INTRODUCTION TO EMBEDDED SYSTEMS

Complex systems and microprocessors-embedding computers, characteristics of embedded computing applications, challenges in embedded computing system design, performance in embedded computing; The embedded system design process-requirements, specification, architecture design, designing hardware and software, components, system integration, design example.

UNIT-II: TYPICAL EMBEDDED SYSTEM

Core of the embedded system-general purpose and domain specific processors, ASICs, PLDs, COTs; Memory-ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems; Sensors, actuators and other components-sensors, actuators, seven segment LED, relay, piezo buzzer, push button switch, reset circuit, brownout protection circuit, oscillator circuit real time clock, watch dog timer.

UNIT-III: EMBEDDED FIRMWARE DESIGN AND DEVELOPMENT

Embedded firmware design approaches-super loop based approach, operating system based approach; Embedded firmware development languages-assembly language based development, high level language based development; Programming in embedded C.

UNIT-IV: RTOS BASED EMBEDDED SYSTEM DESIGN

Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling: non-preemptive and pre-emptive scheduling; task communication-shared memory, message passing.

UNIT-V: COMMUNICATION INTERFACE

Onboard communication interfaces-I2C, SPI, UART, 1 wire interface, parallel interface; External communication interfaces-RS232 and RS485,USB, infrared, Bluetooth, wi-Fi, zigbee, GPRS; Automotive networks and sensor networks.

TEXT BOOKS:

Computers as Components –Wayne Wolf, Morgan Kaufmann (second edition).

Introduction to Embedded Systems - shibu k v, Mc Graw Hill Education.

REFERENCES:

Embedded System Design -frank vahid, tony grivargis, john Wiley.

Embedded Systems- An integrated approach - Lyla b das, Pearson education 2012.

Embedded Systems – Raj kamal, TMH. 4. An embedded Software Primer, David e Simon, Pearson education

EC4414 Detection and Estimation Theory

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**4-0-3**

Course Objectives:

- 1.To enable the students to acquire the fundamental concepts of Signal detection and estimation
- To expose the conceptual basics of Hypotheses.
- To introduce the methods of Detection and estimation of signals in white and non-white Gaussian noise.
- To familiarize with the detection of random signals.
- To enable the students to understand the time varying waveform detection and its estimation.

Course Outcomes:

- After completion of the course the student will be able to
- Understand the basic concepts of Signal detection and estimation.
- Understand conceptual basics of Hypotheses.
- Understand the conceptual basics of Detection and estimation of signals in white and non-white Gaussian noise.
- Understand the detection of random signals.
- Understand the time varying waveform detection and its estimation.

UNIT –I: Random Processes

Discrete Linear Models, Markov Sequences and Processes, Point Processes,and Gaussian Processes.

UNIT –II: Detection Theory

Basic Detection Problem, Maximum A posteriori Decision Rule,Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)-minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

UNIT –III: Linear Minimum Mean-Square Error Filtering

Linear Minimum Mean Squared Error stimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with tored Data, Real-time Digital Wiener Filters, Kalman Filters.

UNIT –IV: Statistics

Measurements, Nonparametric Estimators of Probability Distribution and DensityFunctions,Point Estimators of Parameters, Measures of the Quality of Estimators, Introductionto Interval Estimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression,Multiple Linear Regression.

UNIT –V: Estimating the Parameters of Random Processes from Data

Tests for Stationarity andErgodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Special Density Functions.

TEXT BOOKS:

Random Signals: Detection, Estimation and Data Analysis - K. Sam Shanmugan&A.M.Breipohl, Wiley India Pvt. Ltd, 2011.

Random Processes: Filtering, Estimation and Detection - Lonnie C. Ludeman, Wiley India Pvt. Ltd., 2010.

REFERENCES:

Fundamentals of Statistical Signal Processing: Volume I Estimation Theory– Steven.M.Kay,Prentice Hall, USA, 1998.

Fundamentals of Statistical Signal Processing: Volume I Detection Theory– Steven.M.Kay,Prentice Hall, USA, 1998.

Introduction to Statistical Signal Processing with Applications - Srinath, Rajasekaran,Viswanathan, 2003, PHI.

EC4421 ANALOG VLSI AND MIXED SIGNAL DESIGN

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**4-0-3**

Course Objective:

- To understand the types of active filters and its operation.
- To understand the types of continuous time filters and digital filters and its operation.
- To understand various ADC and DAC converters and its importance in the Electronic systems.
- Gives Knowledge on VHDL Programming language for Mixed Signal Circuit Design.
- Extension the Verilog concepts for analog VLSI circuits.

Course Outcomes:

- Able to design filters with active devices only.
- Able to design the first and second order digital filters.
- The ability to use and design DAC and ADC techniques for data conversions.
- The ability to program, Mixed Signal VLSI Circuits.
- Verilog program for analog VLSI circuits.

UNIT I: Introduction to Active Filters (PLL) & Switched capacitor filters

Active RC Filters for monolithic filer design: First & Second order filter realizations - universal active filter (KHN)- self tuned filter - programmable filters - Switched capacitor filters: Switchedcapacitor resistors - amplifiers –comparators - sample & hold circuits – Integrator-Biquad.

UNIT II: Continuous Time filters & Digital Filters

Introduction to Gm - C filters - bipolar transconductors - CMOS Transconductors using Triode transistors, active transistors - BiCMOStransconductors – MOSFET C Filters - Tuning Circuitry - Dynamic range performance -Digital Filters: Sampling – decimation – interpolation - implementation of FIR and IIR filters.

UNIT III: Digital to Analog & Analog to Digital Converters

Non-idealities in the DAC - Types of DAC’s: Current switched, Resistive, Charge redistribution (capacitive), Hybrid, segmented DAC’s - Techniques for improving linearity - Analog to Digital Converters: quantization errors -non-idealities - types of ADC’s: Flash, two step, pipelined, successive approximation, folding ADC’s.Sigma Delta Converters: Over sampled converters - over sampling without noise & with noise – implementation imperfections - first order modulator - decimation filters- second order modulator - sigma delta DAC & ADC’s

UNIT IV: Analog and Mixed Signal Extensions to VHDL

Introduction - Language design objectives - Theory of differential algebraic equations - the 1076 .1 Language - Tolerance groups - Conservative systems - Time and the simulation cycle -A/D and D/A Interaction - Quiescent Point - Frequency domain modeling and examples.

UNIT V: Analog Extensions to Verilog

Introduction –data types –Expressions-Signals-Analog Behavior-Hierarchical structures-Mixed Signal Interaction. Introduction - Equation construction - solution - waveform Filter functions - simulator - Control Analysis - Multi -disciplinary model.

TEXT BOOKS:

David A. Johns, Ken Martin, “Analog Integrated Circuit Design” John Wiley & Sons, 2002.

Rudy van de Plassche “Integrated Analog-to-Digital and Digital-to-Analog Converters “,Kluwer 1999.

Antoniou, “Digital Filters Analysis and Design” Tata McGraw Hill, 1998.

REFERENCES:

Phillip Allen and Douglas Holmberg "CMOS Analog Circuit Design" Oxford University. Press, 2000.

BenhardRazavi, “Data Converters”, Kluwer Publishers, 1999.

Jacob Baker, Harry W LI, and David E Boyce “CMOS, Circuit Design Layout and Simulation”, Wiley- IEEE Press, 1 st Edition, 1997.

Tsividis Y P, “Mixed Analog and Digital VLSI Devices and Technology”, Mc-Graw Hill,1996.

EC4422 ANALOG INTEGRATED CIRCUIT DESIGN

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**4-0-3**

Course Objectives:

- Understand the working principle of MOSFET transistor and its equivalent circuit, and also to design the single-stage and multi-stage amplifiers.
- Understand the high frequency and noise analysis in the single-stage and multi-stage amplifiers.
- Gives basic knowledge to design feedback amplifiers and working principle of operational amplifier and its complete circuit.
- Basic understanding to compensate the design with some parameters by taking phase margin and gain margin into account.
- Basic Knowledge to get a supply and temperature independent analog designs.

Course Outcomes:

- Able to understand the working principle of MOSFET transistor, using the MOSFET able to design the various styles of voltage and current amplifiers.
- Able to design the analog circuits by considering noise in the circuit and also for the high frequency analysis.
- Able to design the stable analog circuits with a feedback.
- Able to compensate the analog circuits for desired outputs by modifying the circuit.
- Able to design the temperature and supply independent analog cirucits.

UNIT I : SINGLE STAGE AMPLIFIERS

Basic MOS physics and equivalent circuits and models, CS,, CG and Source Follower ascode and folded cascade configurations, differential amplifiers and current mirror configurations.

UNIT II :HIGH FREQUENCY AND NOISE OF CHARACTERISTICS AMPLIFIERS

Current mirrors, cascode stages for current mirrors, current mirror loads for differential pairs. Miller effect, association of poles with nodes, frequency response of CS, CG and source follower, cascade and differential pair stages Statistical characteristics of noise, noise in single stage amplifiers, noise in differential amplifiers.

UNIT III :FEEDBACK AND OPERATIONAL AMPLIFIERS

Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, One-stage Op Amps, Two-stage Op Amps, Input range limitations, Gain boosting, slew rate, power supply rejection, noise in Op Amps.

UNIT IV : STABILITY AND FREQUENCY COMPENSATION

General considerations, Multipole systems, Phase Margin, Frequency Compensation, Compensation of two stage Op Amps, Slewing in two stage Op Amps, Other compensation techniques.

UNIT V:ANDGAP REFERENCES

supply independent biasing, temperature independent references, PTAT current generation, Constant-Gm Biasing.

TEXT BOOKS:

BehzadRazavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2001.

Phillip E.Allen, DouglasR.Holberg, “CMOS Analog Circuit Design”, Second edition, Oxford University Press, 2002.

REFERENCE BOOKS:

Willey M.C. Sansen, “Analog Design Essentials”, Springer, 2006.

Grebene, “Bipolar and MOS Analog Integrated circuit design”, John Wiley &sons,Inc., 2003.

Recorded lecture available at http://www.ee.iitm.ac.in/~ani/ee5390/index.html.

Jacob Baker “CMOS: Circuit Design, Layout, and Simulation, Third Edition”, Wiley IEEE Press 2010 3rd Edition.

EC4423 CAD OF VLSI CIRCUITS

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To make understand the VLSI CAD tools flow with Algorithmic Graphs.
- Gives knowledge on layout design rules and various algorithms for placement and partitioning of circuits.
- Understands the Floor planning and routing process in the VLSI CAD tools.
- Knows the various concepts of simulation and synthesis process in VLSI CAD tools.
- Gives Knowledge on modelling concepts of synthesis process.

Course Outcomes:

- Understands the complete VLSI CAD tool flow.
- Able to follow the design rules and debug it while creating layouts for circuits in VLSI CAD tool and also understands the placement and partitioning of the digital systems.

- Able to debug the floor planning and routing problems in the VLSI CAD tools for the digital systems.
- Understands the simulation and synthesis process and make advantage to debug the errors when developing and using the VLSI CAD tools.
- Able to develop a synthesis process in the VLSI CAD tools

UNIT I: VLSI DESIGN METHODOLOGIES

Introduction to VLSI Design methodologies - Review of Data structures and algorithms - Review of VLSI Design automation tools - Algorithmic Graph Theory and Computational Complexity - Tractable and Intractable problems - general purpose methods for combinatorial optimization.

UNIT II:DESIGN RULES

Layout Compaction - Design rules - problem formulation - algorithms for constraint graph compaction - placement and partitioning - Circuit representation - Placement algorithms - partitioning

UNIT III:FLOOR PLANNING

Floor planning concepts - shape functions and floorplan sizing - Types of local routing problems - Area routing - channel routing - global routing - algorithms for global routing.

UNIT IV:SIMULATION

Simulation - Gate-level modeling and simulation - Switch-level modeling and simulation - Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis.

UNIT V:MODELLING AND SYNTHESIS

High level Synthesis - Hardware models - Internal representation - Allocation assignment and scheduling - Simple scheduling algorithm - Assignment problem - High level transformations.

TEXTBOOKS:

S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.

N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.

EC4424 RF Integrated Circuits

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To educate students fundamental RF circuit and system design skills.
- To introduce students, the basic transmission line theory, single and multiport networks, RF component modelling.
- To offer students experience on designing matching and biasing networks & RF transistor amplifier design.

Course Outcomes:

- At the end of this course Students will learn:
- Understand the design bottlenecks specific to RF IC design, linearity related issues, ISI.

- Identify noise sources, develop noise models for the devices and systems.
- Specify noise and interference performance metrics like noise figure, IIP3 and different matching criteria.
- Comprehend different multiple access techniques, wireless standards and various transceiver architectures
- Design various constituents' blocks of RF receiver front end.

Unit I: INTRODUCTION TO RF AND WIRELESS TECHNOLOGY:

Complexity comparison, Design bottle necks, Applications, Analog and digital systems, Choice of Technology. BASIC CONCEPTS IN RF DESIGN: Nonlinearity and time variance, ISI, Random process and noise, sensitivity and dynamic range, passive impedance transformation.

Unit II: MULTIPLE ACCESS:

Techniques and wireless standards, mobile RF communication, FDMA, TDMA, CDMA, Wireless standards.

Unit III: TRANSCEIVER ARCHITECTURES:

General considerations, receiver architecture, Transmitter Architecture, transceiver performance tests, case studies.

Unit IV: AMPLIFIERS, MIXERS AND OSCILLATORS:

LNAs, down conversion mixers, Cascaded Stages, oscillators, Frequency synthesizers.

Unit V: POWER AMPLIFIERS:

General considerations, linear and nonlinear Pas, classification, High Frequency power amplifier, large signal impedance matching, linearization techniques.

Text Books:

BehzadRazavi, RF Microelectronics Prentice Hall of India, 2001

Thomas H. Lee, the Design of CMOS Radio Integrated Circuits, Cambridge University Press.

EC4425 **Adhoc Wireless Sensor Networks**

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To introduction of fundamentals of Wireless LANS and PANS and its design issues.
- To understand the MAC protocols for Ad Hoc Wireless Networks and its designingissues.
- To introduction of different kinds of Routing algorithms for effective design of Ad HocWireless Networks.
- To introduction and designing issues in Transport Layer Protocol for Ad Hoc WirelessNetworks.
- Introduction of Wireless Sensor Networks and its Architecture.

Course Outcomes:

- At the end of this course Students will learn
- Students will be good at fundamentals of Wireless LANS and PANS and its designissues.
- Students will know the MAC protocols for Ad Hoc Wireless Networks and its
- designing issues.
- Student knows the different kinds of Routing algorithms for effective design of Ad
- Hoc Wireless Networks.
- Student will be ability to overcome the issues in Transport Layer Protocol for Ad Hoc
- Wireless Networks.
- Finally, student will be good at design and architecture of Wireless Sensor Networks.

UNIT -I:

Wireless LANS and PANS: Introduction, Fundamentals of WLANS, IEEE 802.11 Standards,HIPERLAN Standard, Bluetooth, Home RF.AD HOC Wireless Networks: Introduction, Issues in Ad Hoc Wireless Networks.

UNIT -II:

MAC Protocols: Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation

Mechanisms,Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocolsthat use Directional Antennas, Other MAC Protocols.

UNIT -III:

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc WirelessNetworks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – DemandRouting Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols.

UNIT –IV:

Transport Layer Protocols: Introduction, Issues in Designing a Transport Layer Protocol for AdHoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

UNIT –V:

Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

TEXT BOOKS:

Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI.

Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control – JagannathanSarangapani, CRC Press.

REFERENCES:

Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh , 1st Ed. Pearson Education.

Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer.

EC4426 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**4-0-3**

Course Objectives:

This course provides

- An introduction to measurement techniques and instrumentation design and operation
- The basic concepts of units measurement error and accuracy, the construction and design of measuring devices and circuits measuring instruments and their proper applications
- To use different measuring techniques and measurement of different physical parameters using different transducers

Course Outcomes:

- Upon a successful completion of this course, the student will be able to:
- Describe the fundamental concepts and principles of instrumentation.
- Explain the operations of the various instruments required in measurements.
- Apply the measurement techniques for different types of tests.
- To select specific instrument for specific measurement function.
- Understand principle of operation, working of different electronic instruments like digital multi meter, vector voltmeter.
- Learners will apply knowledge of different oscilloscopes like CRO, DSO.
- Students will understand functioning, specification, and applications of signal analyzing instruments.

UNIT - I:

Block Schemantics of Measuring Systems: Performance characteristics, Static characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag; Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

UNIT - II:

Signal Analyzers: AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary waveform Generator, Video Signal Generators, and Specifications.

UNIT - III:

Oscilloscopes: CRT, Block Schemantic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Strorage Oscilloscopes, Digital Storage CROs.

UNIT - IV:

Transuducers: Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperatue sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

UNIT - V:

Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

Measurement of Physical Parameters: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure - High Pressure, Vacuum level, Temperature - Measurements, Data Acqisition Systems.

TEXTBOOKS:

Electronic instrumentation: H.S.Kalsi - TMH, 2nd Edition 2004.

Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI, 5th Edition, 2003.

REFERENCES:

Electronic Instrumentation and Measurements - David A. Bell, Oxford Uiv. Press, 1997.

Electronic Measurements and Instrumentation: B. M. Oliver, J. M. Cage TMH Reprint.

Measurement Systems - Emest O. Doebelin and Dhanesh N Manik, 6th Ed., TMH.

Electronic Measurements and Instrumentations by K. Lal Kishore, Pearson Education - 2010.

Industrial Instrumentation: T. R. Padmanabham Spiriger 2009.

EC4431 **Digital Image Processing**

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- Learn and understand the representation of Two Dimensional Linear shift invariant Systems using Matrices
- To understand the acquisition of digital images.
- Learn and implement the algorithms for basic image processing applications such as image enhancement
- Formulate and solve the optimization problems to achieve image restoration from degraded images
- To implement, analyze, and asses the performance of the image processing algorithms.

Course Outcomes:

- To Introduce the applications of the Digital image processing in different research fields, and learn the Mathematical preliminaries required for analyzing two dimensional systems.
- Learn the acquisition process of a Digital images
- Demonstrated understanding of Image transforms such as Discrete Fourier Transform, Cosine Transform, Hadamard Transform, and KLT.
- Demonstrated understanding of image enhancement techniques
- Understanding of formulation and solution of image restoration techniques

UNIT-I: INTRODUCTION, Mathematical Preliminaries and Two dimensional Systems

Introduction to image Processing and applications of image processing in different fields, Fundamentals of Linear algebra, and Probability, one dimensional and two dimensional Linear shift invariant systems and their representation using matrices, one dimensional and Two Dimensional Convolution, Separable operations using matrices, Two dimensional Discrete time Fourier transform, Two dimensional Z transform and Properties.

UNIT-II: Image sampling and Quantization

Sampling of One dimensional signals, Sampling of Two dimensional signals, Anti-aliasing filter, Quantization: Liyod Max quantizer, Uniform quantizer, Signal to quantization noise ratio.

UNIT-III: Image Transforms

Unitary transforms and properties, One dimensional Discrete Fourier transform, Two dimensional Discrete Fourier transform, One dimensional Discrete cosine transform, Two dimensional Discrete cosine transform, One dimensional Discrete sine transform, Two dimensional Discrete sine transform, One dimensional Discrete Walsh transform, Two dimensional Discrete Walsh transform, One dimensional Discrete Hadamard transform, Two dimensional Discrete Hadamard transform, One dimensional Discrete Haar transform, Two dimensional Discrete Haar transform, One dimensional Discrete KLT transform, Two dimensional Discrete KLT transform, Application of KLT for Face recognition.

UNIT-IV: Image Enhancement

Point operations: contrast stretching, digital negative, Power law correction, dynamic range compression, intensity level slicing, Thresholding, Bit plane extraction; Histogram equalization and histogram specification; spatial operations:Linear and non linear filtering in spatial domain using spatial masks, Unsharp masking; Transform Operations: Filtering in transform domain; Psuedo coloring

Unit – V: Image Restoration

Classification of restoration methods, Characteristic metrics for Image restoration, Linear and non linear degradation models, Inverse filtering, Pseudo inverse filtering, Wiener filtering: Least squares approach.

REFERENCES:

A.K Jain , Fundamentals of Digital Image Proceessing, Prentice Hall.

R. C. Gonzalez, R.E. Woods, Digital Image Processing, Pearson.

EC4432 MULTIMEDIA COMMUNICATION

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives

- The course is designed
- To provide an introduction to the fundamental principles and techniques in Multimedia Signal coding and compression.
- To give an overview of current multimedia standards and technologies.
- To provide techniques related to computer and multimedia networks.
- To provide knowledge related to Multimedia Network Communications and Applications.

Course Outcomes

- Upon completing the course, the student will be able to:
- Understand the fundamentals behind multimedia signal processing.
- Understand the fundamentals behind multimedia compression.
- Understand the basic principles behind existing multimedia compression and communication standards.

- Understand future multimedia technologies.
- Apply the acquired knowledge to specific multimedia related problems and projects at work.
- Take advanced courses in this area.

UNIT -I

Introduction to Multimedia: Multimedia, World Wide Web, Overview of Multimedia Tools, Multimedia Authoring, Graphics/Image Data Types, and File Formats.

Color in Image and Video: Color Science — Image Formation, Camera Systems, Gamma Correction, Color Matching Functions, CIE Chromaticity Diagram, Color Monitor Specifications, Out-of-Gamut Colors, White Point Correction, XYZ to RGB Transform, Transform with Gamma Correction, L*A*B* Color Model. Color Models in Images — RGB Color Model for CRT Displays, Subtractive Color: CMV Color Model, Transformation from RGB to CMV, Under Color Removal: CMYK System, Printer Gamuts, Color Models in Video — Video Color Transforms, YUV Color Model, YIQ Color Model, Ycbcr Color Model.

UNIT -II

Video Concepts: Types of Video Signals, Analog Video, Digital Video.

Audio Concepts: Digitization of Sound, Quantizatiofl and Transmission of Audio.

UNIT -III

Compression Algorithms

Lossless Compression Algorithms: Run Length Coding, Variable Length Coding, Arithmetic Coding, Lossless JPEG, Image Compression.

Lossy Image Compression Algorithms: Transform Coding: KLT And DCT Coding, Wavelet Based Coding.

Image Compression Standards: JPEG and JPEG2000.

UNIT – IV

Video Compression Techniques: Introduction to Video Compression, Video Compression Based on Motion Compensation, Search for Motion Vectors, H.261- Intra-Frame and Inter-Frame Coding, Quantization, Encoder and Decoder, Overview of MPEG 1 and MPEG2.

UNIT -V

Audio Compression Techniques: ADPCM in Speech Coding, G.726 ADPCM, Vocoders Phase Insensitivity, Channel Vocoder, Formant Vocoder, Linear Predictive Coding, CELP, Hybrid Excitation Vocoders, MPEG Audio — MPEG Layers, MPEG Audio Strategy, MPEG Audio Compression Algorithms, MPEG-2 AAC, MPEG-4 Audio.

TEXT BOOKS

Fundamentals of Multimedia — Ze- Nian Li, Mark S. Drew, PHI, 2010.

Multimedia Signals & Systems — Mrinal Kr. Mandal Springer International Edition 1St Edition, 2009

REFERENCE BOOKS

Multimedia Communication Systems — Techniques, Stds&Netwroks KR. Rao, Zorans. Bojkoric, DragoradA.MjIovanj 1st Edition, 2002.

Fundamentals of Multimedia Ze- Man Li, Mark S.Drew, Pearson Education (LPE), 1st Edition, 2009.

Multimedia Systems John F. KoegelBufond Pearson Education (LPE), 1st Edition, 2003.

Digital Video Processing — A. Murat Tekaip, PHI, 1996.

Video Processing and Communications — Yaowang, JornOstermann, Ya-QinZhang, Pearson,2002

EC4433 DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To introduce architectural features of programmable DSP Processors of TI and AnalogDevices.
- To recall digital transform techniques.
- To give practical examples of DSP Processor architectures for better understanding.
- To develop the programming knowledge using Instruction set of DSP Processors.
- To understand interfacing techniques to memory and I/O devices.

Course Outcomes:

- Student will be able to:
- To distinguish between the architectural features of general purpose processors and DSP processors
- Understand the architectures of TMS 320C54XX and ADSP2100 DSP devices

- Able to write assembly language programs using instruction set of TMS320C54XX
- Can interface various devices to DSP Processors

UNIT-I: Introduction to Digital Signal Processing:

Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolationComputational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT-II: Architectures for Programmable DSP Devices:

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT-III: Programmable Digital Signal Processors:

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.

UNIT-IV: Analog Devices Family of DSP Devices:

Analog Devices Family of DSP Devices – ALU and MAC block diagram, ShifterInstruction,Base Architecture of ADSP 2100, ADSP-2181 high performance Processor. introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

UNIT-V: Interfacing Memory and I/O Peripherals to Programmable DSP Devices:

Memory space organization, External bus interfacing signals, Memory interface, ParallelI/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TEXT BOOKS:

Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.

A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009

Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

REFERENCES:

Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.

Digital Signal Processing – Jonatham Stein, 2005, John Wiley.

DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.

Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI

The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D.,California Technical Publishing, ISBN 0-9660176-3-3, 1997 6.Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005.

EC4434 ANTENNAS AND WAVE PROPAGATION

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- Understand basic terminology and concepts of Antennas.
- To attain knowledge on the basic parameters those are considered in the antenna design process and the analysis while designing that.
- Analyze the electric and magnetic field emission from various basic antennas and
- mathematical Formulation of the analysis.
- To have knowledge on antenna operation and types as well as their usage in real time filed.
- Aware of the wave spectrum and respective band based antenna usage and also to know thepropagation of the waves at different frequencies through different layers in the existing layered free space environment structure.

Course Outcomes:

- Student will be able to:
- Aware of antenna parameter considerations
- Capable to analyze the designed antenna and field evaluation under various conditions andformulate the electric as well as magnetic fields equation set for far field and near field conditions
- Understand the array system of different antennas and field analysis under application of different currents to the individual antenna elements
- Understand the design issues, operation of fundamental antennas and their operation

- methodology in practice.
- Design a lens structure and also the bench set up for antenna parameter measurement of testingfor their effectiveness
- Knowledge about the means of propagation of electromagnetic waves

UNIT-I: Antenna Basics:

Introduction, Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Illustrative Problems. Fields fromOscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation, Retarded Potentials – Helmholtz Theorem.Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area, Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths, Illustrative Problems. Loop Antennas - Introduction, Small Loop, Comparison of Far Fields of Small Loop and Short Dipole, Radiation Resistances.

UNIT-II: Antenna Arrays:

Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, Endfire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions –General Considerations and Binomial Arrays, Illustrative Problems.

Antenna Measurements:Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3- Antenna Methods)

UNIT-III: VHF, UHF and Microwave Antennas-I:

Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics,Helical Antennas – Helical Geometry, Helix Modes, Practical Design Considerations for Monofilar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types, Optimum Horns, Design Considerations of Pyramidal Horns, Illustrative Problems.

VHF, UHF and Microwave Antennas - II:

Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas– Geometry and Parameters, Characteristics of Microstrip Antennas. Impact of Different Parameters on Characteristics, 103 Reflector Antennas – Introduction, Flar Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features, Illustrative Problems. Lens Antennas – Introduction, Geometry of Non-metallic Dielectric Lenses, Fermat‘s Principle, Zoning, Applications.

UNIT-IV: Wave Propagation – I:

Introduction, Definitions, Categorizations and General Classifications, Different Modes of WavePropagation, Ray/Mode Concepts, Ground Wave Propagation (Qualitative Treatment) Introduction, Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections. Space Wave Propagation – Introduction, Field Strength Variation with Distance andHeight, Effect of Earth‘s Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering Phenomena, Tropospheric Propagation.

UNIT-V: Wave Propagation – II:

Sky Wave Propagation – Introduction, Structure of Ionosphere, Refraction and Reflectionof Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multihop Propagation.

TEXT BOOKS:

Antennas and Wave Propagation – J.D. Kraus, R.J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 4thed., (Special Indian Edition), 2010.

Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd ed.2000.

A.Harish, M.Sachidanada," Antennas and Wave Propagation", Oxford University Press,2007

REFERENCES:

Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.

Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications,New Delhi,2001.

Transmission and Propagation – E.V.D. Glazier and H.R.L. Lamont, The Services Text Book of Radio,vol. 5, Standard Publishers Distributors, Delhi.

Antennas – John D. Kraus, McGraw-Hill (International Edition), 2nd Ed. 1988.

Electronic and Radio Engineering – F.E. Terman, McGraw-Hill, 4th edition, 1955.

EC4435 Biomedical signal Processing

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Outcomes:

1. To understand the origin, acqusition and processing of Bio signals and their application for diagnosis, and different Imaging modalities

2. To understand the cardiac and brain signal processing for various applications

3. To learn fundamentals of digital images, and 2 D systems, and various image transforms

4. To learn image enhancement and image restoration methods

5. To learn different classification techniques

Chapter 1:Introduction to bio Signals and Bio images

The Nature of Biomedical SignalsExamples of Biomedical Signals,Origin of bio potenials, The action potential of a cardiac myocyte,The action potential of a neuron,The electroneurogram (ENG),The electromyogram (EMG),The electrocardiogram (ECG).The electroencephalogram (EEG),Event-related potentials (ERPs),The electrogastrogram (EGG),The phonocardiogram (PCG),The carotid pulse,Signals from catheter-tip sensors,The speech signal,The vibromyogram (VMG),The vibroarthrogram (VAG),Otoacoustic emission (OAE) signals,Bioacoustic signals. Biomedical images: Different imaging modalities, Computer aided Tomography

Chapter 2: Cardiac and Brain signal Processing

Acqusition of ECG: Standard 12 lead system, ambugulatory ECG signal, Fundamental Prolems of Cardiac signal Processing, Pre processing techniques, QRS detection: Categorisation, Pam Tompkins technique, Automatic heart beat classification, AAMI standard, Review of methods of heart beat classification,

Chapter 3:

Digital image acquisition, sampling and quantization, Response of 1D LSI system for non-periodic and periodic inputs (Using matrix method), Response of Two dimensional LSI systems for non periodic and periodic inputs using row ordered vector form of images, Image transforms: Unitary transforms and properties, Discrete Fourier transform, Discrete Cosine transform, Discrete sine transform, Walsh transform, Hadmard transform, Haar transform, KL transform

Chapter 4:

Image enhancement: Point processing techniques: Contrast stretching, dynamic range compression, Power law correction, Bit plane slicing, Gray level slicing, thresholding, Hisogram equalization, Histogram matching, Neighbour hood processing: LSI filtering, Low pass filters, High pass filters: First order and second order derivative filtes, High boost filtering, Frequency domain processing

Image Restoration: Difference between Image restoration and Image enhancement, Performance metrics, Simplifies model for degradation using LSI approximation, methods of estimation of degradation function, Models for different degradations, Inverse filtering, effect of noise on inverse filtering: Least sqaures filtering, Constrained Least squares filtering, Weiner filtering

Chapter 5:

Data preprocessing, Feature extraction methods, Regression, Classification: Supervised and Unsupervised learning, Nearest neighbour classification, Bayesian classifier, K Nearest neighbour classification, Support vector machine, Artifical neural networks, K means clustering,

Reference Books:

1. “BIOMEDICAL SIGNAL ANALYSIS”, RANGARAJ M. RANGAYYAN, IEEE press, Wiley

2. “Fundamentals of Digital image processing” by A.K Jain, PhI

3. “Digital image processing”, R. Gonzalez and Woods

EC4502 Data Mining

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Objectives:

1. To impart an introduction to Data Mining.
2. To develop basic knowledge of how data is transformed to Data Warehouses.

UNIT - I:

Introduction to Data Mining: What is data mining? Related technologies - Machine Learning, DBMS, OLAP and Statistics. Data Mining Goals, Stages of the Data Mining Process , Data Mining Techniques. Knowledge Representation Methods, Applications. Example: weather data
Data Warehouse and OLAP: Data Warehouse and DBMS, Multidimensional data model , OLAP operations, Example:loan data set.

UNIT - II:

Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies.
Data mining knowledge representation: Task relevant data, Background knowledge, Interestingness measures, Representing input data and output knowledge

Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures

UNIT - III:
Data mining algorithms: Association rules - Motivation and terminology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis.
Data mining algorithms: Classification - Basic learning/mining tasks, Bayesian, Naïve Bayes , Decision trees, Covering rules, Random Forest.

UNIT - IV:
Data mining algorithms: Prediction - The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), Linear models
Evaluating what's been learned: Basic issues, Training and testing, Estimating classifier accuracy (holdout, cross-validation, leave-one-out), Combining multiple models (bagging, boosting, stacking), Minimum Description Length Principle (MLD)

UNIT - V:
Clustering: Basic issues in clustering, First conceptual clustering system: Cluster/2 , Partitioning methods: k-means, expectation maximization (EM), Hierarchical methods: distance-based agglomerative and divisible clustering
Basics of ANN, Perceptron, MLP
Suggested References:

1. I. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2000.
2. J. Han and M. Kamber. Data Mining: Concepts and Techniques, 2nd Ed. Morgan Kaufman. 2006.
3. M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education. 2001.
4. D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001.
5. Pang-Ning Tan, Michael Steinbach, Vipin Kumar. Introduction to Data Mining. Addison-Wesley Longman Publishing Co.

EC4503 Machine Learning Techniques 4L-0-0-3 (3 credits)

Course Objectives:

- To introduce students to the basic concepts and classical techniques of Machine Learning.
- To study optimization algorithms used in Machine learning.
- To study various classification techniques, regression, clustering, ANN.

- To study Deep learning concepts: CNN, RNN and hyper parameter tuning, some case studies.

UNIT-1 (Introduction):

Introduction to Machine Learning: Supervised learning, Unsupervised learning, Reinforcement learning. Machine Learning applied to AI examples. Structured data, Unstructured data, training data, test data, cross validation, data collection (Unbiased data), data cleaning, feature extraction, Properties of best features for classification. Linear Regression, Logistic Regression. Over fitting problem. Bias-Variance tradeoff.

UNIT-2 (Classical Techniques of ML):

Error metrics, error metrics for skewed classes, Gradient Descent algorithms: Batch, mini-batch, Stochastic Gradient descent.

Classification Techniques: Bayes classifier, Naïve Bayes classifier, K-Nearest neighbor, Perceptron learning algorithm, Multi-layer Perceptron, Regularization, Support Vector Machines, Decision tree algorithm.

Clustering: K-means clustering

Dimensionality Reduction, Anomaly detection.

UNIT-3 (Artificial Neural Networks):

Introduction to Neural networks, back propagation algorithm. Activation functions: Sigmoid, tanh, ReLU, SoftMax. Regularization techniques.

UNIT-4 (CNN)

Deep learning, vanishing gradients problem, Hyper parameters.

CNN and applications to Computer Vision.

Hyper parameters tuning.

Case studies: LeNet-5, AlexNet, VGG-16, ResNets

Self-driving car application.

Generative Adversial Networks (GAN)

UNIT-5 (RNN)

RNN and application to sequence modeling. Hyper parameters tuning.

Some Case studies.

Course Outcomes:

At the end of the course, students will learn the various algorithms related to Supervised Learning, Unsupervised learning, Deep learning concepts.

Text Books:

1. Deep Learning, Goodfellow et al, MIT Press
2. Pattern Recognition and Machine Learning, Christopher Bishop, Springer

Reference MOOCs:

1. "Machine Learning" by Prof.Andrew NG, Coursera (Stanford)
2. "Deep Learning" by Prof.Andrew NG, Coursera (Stanford)

EC4701 Microprocessor and Microcontroller Lab

Externals: 60Marks	**(L-T)-P-C**
Internals: 40Marks	**0-3-2**

LIST OF EXPERIMENTS:

1. Familiarization with TITAN II Kit's hardware and usage of Triton IDE along with Flash Magic for dumping the code to the controller by blinking on board LEDs.

2. Interface simple seven segment LED display with controller.

3. To Display "DEPT OF ECE" on LCD in 8-bit as well as 4-bit mode

4. Interface Keyboard and LCD with controller.

5. Interface Stepper Motor by controlling its direction and make it spin faster or slower.

6. Interface DC motor and control its speed using PWM technique.

7. Interface Elevator to the controller.

8. Interface Traffic Light with controller.

9. Interfacing ADC to Microcontroller.

10. Interface DAC with Microcontroller and generate multiple waveforms.

11. Interface Temperature Sensor to ADC and measure it on LCD with microcontroller.

List of Free-electives :

SUBJECT CODE	SUBJECT NAME	L-T	P	C
BM4402	Production and Project Management	4	0	3
BSBE4401	BIOINFORMATICS	4	0	3
BSBE4402	INDUSTRIAL BIOTECHNOLOGY	4	0	3
BSBE4403	BIOMEDICAL ENGINEERING	4	0	3

BSBE 4401 BIOINFORMATICS

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **3-0-0-3**

Course Objectives: To give an overview of the existing methodologies adopted in computational analysis of biological data. The main objective of the course is to stress the need for algorithm and data processing technologies for analysis and decoding the information processing of biological systems.

Course Outcome: This course improves the critical intellectual faculty required for handling and analyzing large data sets. It also stresses the need for integrating information to solve problems. The gap in resolving biological problems with the aid of core domain knowledge of different disciplines can be curtailed with the help of this course since it embarks the student with the skills to gather and integrate the required biological information. Students interested in developing algorithms and data processing technologies for analyzing biological information have huge demands since the applications of this branch play a vital role in alleviating bottlenecks in drug development.

UNIT-1: Biological Data Bases

1. Introduction to Bioinformatics -History of Bioinformatics- Internet and Bioinformatics

2. Introduction – Data base definition, data, Biological databases- Types of databases- conventions for databases indexing and specification of search terms

3. Contents and formats of database entries – retrieval of data using text based search tools – sources of data (Ex. Sequencing projects, Patent office's etc.), Method for deposition of data to databases.

4. Nucleic acid sequence databases – Genbank, EMBL, DDBJ

5. Protein sequence database – Primary sequence database. Introduction to protein information Resource (PIR)- Martinsried institute of Protein Sequence (MIPS), SWISS- PROT , Structure of SWISS- PROT Entries, Translated EMBL (TrEMBL)

6. Secondary sequence Database- Introduction to PROSITE, PROFILE, PRINTS, BLOCK, pfam and IDENTITY databases.

7. Genome Databases at NCBI, EBI, TIGR, SANGER.

8. Structural and Related Databases – PDB, NDB, CCSD, Prosite, PRODOM, Pfam, CATH, SCOP, DSSP, FSSP, DALI

UNIT-2: Sequence Analysis

9. Various file formats for Bio – molecular sequences – Genbank, FASTA, GCG, MSF, NBRF-PIR. Basic concepts of sequence similarity, identity and homology, definitions of homologues, orthologues, Paralogues

10. Scoring matrices- Basic concept of a scoring matrix- matrices for nucleic acid and protein sequences – PAM and BLOSUM matrices – Principles based on which these matrices are derived

11. Sequence – based Database searches- What are Sequence based database searches, BLAST and FASTA algorithms. Various versions of Basic BLAST and FASTA. Use of these methods for sequence analysis

12. Pairwise sequence Alignments- Basic concepts of sequence alignment, Needleman & Wuncsh, Smith & Waterman algorithms for Pair wise alignments – use of pair wise alignments for analysis of nucleic acid and protein sequences

13. Sequence Patterns and profiles – Basic concept and definition of sequence patterns, motifs and profiles, various types of pattern representations- namely consensus, regular expression and profiles.

14. Profile based database searches using PSI- BLAST, analysis and interpretation of profile – based searches

UNIT-3: Phylogenetic Analysis

15. Introduction – Evolution, definition of phylogenetic tree – nodes, internodes , root , tree , styles, cladogram, Phenogram, curvogram

16. Steps involved in construction of Phylogenetic tree

17. Methods of Phylogenetic analysis – Distance method, character based method

18. Tree Evaluation – Jumbling sequence addition order, Boot strap method.

19. Problems in Phylogenetic analysis- Phylogenetic analysis tool (Phylip, Clustalw,Tree view)

Unit 4: Applications of Bio Informatics

20. Chemiinformatics in Biology- conventions for representing molecules – Chemiinformatics, resources

21. Bioinformatics in Pharmaceutical industries and Medical Sciences, Immunology, Agriculture, Forestry, Geo Informatics, Bio sensing.

22. Legal, Ethical and commercial ramifications of bioinformatics

REFERENCES

1. *David E. Mount. Textbook of Bioinformatics. Cold Spring Harbor (CSH) publication.*
2. *D. Baxavenis, and B. F. F. Ouellette, Bio informatics- A Practical guide to the analysis of Genes and Proteins, 2nd ed., John Wiley and Sons Inc., 2001.*
3. *A.R Leach, Molecular Modeling: Principles and Applications, Addisons-Wesley Pub Co.1997.*
4. *P.E.Bourne and H.Weissig, Structural Bioinformatics, WILEY, 2003.*
5. *T.Lenguer, Bioinformatics-From Genome to Drug, Vols 1 and 2,Wiley-VCH,2002.*
6. *B.Brayn, Bioinformatics computing: the comlete practical guide to bioinformatics for life scientists,Prentice Hall, 2000.*
7. *Misner and S.A. Krawetz, Bioinformatics: methods and protocols,Hanuma Press,2000.*
8. *S.A. krawetz and D.D. Womble, Introduction to Bioinformatics: a theoretical and practical approach, Hanuma Press,2003.*
9. *D.Higgins and W.Taylor (ed), Bioinformatics: sequence ,structure and databanks-a practical approach, Oxford, 2000.*
10. *Prof. P.B. Kavi Kishor and L.N. Chavali, Principlesof Biological Databases, Himalaya Publishers, 2013.*

BSBE 4402 INDUSTRIAL BIOTECHNOLOGY

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **3-0-0-3**

Course Objectives:

-Discuss the significance of industrial biotechnology.

-Explain the large-scale production of biomolecules using bioreactors.

-Discuss the types of fermenters and their applications.

-Discuss upstream an downstream process for biotechnology products.

-Explain biosafety issues and automation of industrial plants.

-Discuss product validation and regulation of biotechnology products.

-Discuss industrial applications of microbes, plants, mammalians cells in biotechnology development.

UNIT-1: INTRODUCTION TO INDUSTRIAL BIOPROCESS

Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and modern Biotechnology, A brief survey of organisms, processes, products. Basic concepts of Upstream and downstream processing in Bioprocess, Bioreactors - design and types.

UNIT 2 : PRODUCTION OF PRIMARY AND SECONDAR METABOLITES

Primary Metabolites – Production of commercially important primary metabolites Like organic acids, amino acids and alcohols. Secondary Metabolites – Production processes for various classes of secondary metabolites, antibiotics, vitamins and steroids.

UNIT 3 : ENZYME BIOTECHNOLOGY AND OTHER BIOPRODUCTS

Industrial use and production of Enzymes (Cellulases, proteases Lipases etc.), immobilization of Enzymes and applications. Biosensors, Biopesticides, Biofertilizers, Biopreservatives, Biopolymers, biofuels – biogass, biodiesel, bio hydrogen, bio ethanol, microbial fuel cell technology. Biodegradable plastics, biorefineries to generate electricity.

UNIT 4: FOOD BIOTECHNOLOGY

Food preservation through canning, sterilization, pasteurization, chemicals, radiations drying and packing. Food spoilage-Biotechnology process for prevention of food spoilage. Fermented foods and pro-biotics. Microbial foods- SCP.

UNIT 5 : PRODUCTION OF MODERN BIOTECHNOLOGY PRODUCTS

Production of recombinant proteins having therapeutic and diagnostic applications, vaccines, monoclonal antibodies. Gene therapy, Bioprocess strategies in Plant Cell,Animal and microbial cell cultures.

REFERENCES:

1. *Satyanarayana, U. "Biotechnology" Books & Allied (P) Ltd., 2005.*
2. *Kuma, H.D."A Textbook on Biotechnology" Edition. Affiliated East West Press Pvt. Ltd., 1998.*
3. *Balasubramanian, D. etal. , "Concepts in Biotechnology" Universities Press Pvt.Ltd., 2004.*
4. *Ratledge, Colin and Bjorn Kristiansen "Basic Biotechnology" 2 nd Edition Cambridge University Press, 2001.*
5. *Dubey , R.C. "A Textbook of Biotechnology" S.Chand & Co. Ltd. , 2006.*

6. *Casida, L.E. "Industrial Microbiology", New Age International (P) Ltd, 1968.*
7. *Presscott, S.C. and Cecil G. Dunn, "Industrial Microbiology", Agrobios India), 2005.*
8. *Microbiology", 2 nd Edition, Panima Publishing, 2000.*
9. *Moo – Y oung, Murrey, "Comprehensive Biotechnology", 4 Vols. Ergamon Press, (An Imprint of Elsevier) 2004.*
10. *Stanbur y, P . F ., A. Whitaker and S.J. Hall "Principles of Fermentation T echnology", 2 nd Edition, Butterworth-Heinemann (an imprint of Elsevier), 1995.*
11. *C. F. A Brycean d EL.Mansi, Fermentation microbiology & Biotechnology, 1999.*
12. *K.G.Ramawat & Shaily Goyal, Comprehensive Biotechnology, 2009, S.Chand publications.*

BSBE 4403 BIOMEDICAL ENGINEERING

Externals: 60 Marks	**L-T-P-C**
Internals: 40 Marks	**3-0-0-3**

Course Objectives:

The students will be able to

1. Interpret technical aspects of medicine.
2. Solve Engineering Problems related to medical field.
3. Understand medical diagnosis and therapy.

Course Outcomes:

On completion of this module students will be able to analyze a problem from both an engineering and biological perspective; they can anticipate the special difficulties of technological intervention in working with living systems and to evaluate a wide range of possible approaches.

Students will be able to apply their engineering domain knowledge with a biological perspective to solve the problems at the interface of engineering and biology.

Addressing the problems associated with the technological interface with living systems, students would be enabled to design a variety of electronic and/or computer-based devices and software for applications including biomedical instrumentation, medical imaging, physiological measurement, biomedical signal processing, rehabilitation engineering and medical informatics.

They will be able to make physical measurements and gather data to reflect biological activity from living systems; and aid in the analysis of biological systems, design of biomedical instruments, and the technological advancement for health care.

UNIT I: HUMAN ANATOMY & PHYSIOLOGY.

Structure and function of Cell & cellular components – Membrane Potential – Action Potential – Generation and Conduction; Overview of Cardiovascular system, Nervous System, Muscular-Skeletal System, Respiratory system, Excretory system.

UNIT 2: PRINCIPLES OF DIAGNOSTIC AND THERAPEUTIC EQUIPMENTS

Normal and abnormal ECG waveform, diagnosis interpretation, cardiac pacemaker, heart lung machines - need for the unit, spirometer, respiratory volume measurement, pnemograph, artificial respirator –ipr type, functioning, pulse oximetry, basic principles of echo technique, display techniques a, b, m, d modes, echo cardiograms, echo encephalogram, ultrasonic applied as diagnostic tool in ophthalmology, obstetrics and gynaecology. Principles of dialysis –Hemodialys.

UNIT 3: MEDICAL IMAGING

Introduction to medical imaging and different medical imaging modalities. Review of Signals and system, Fourier transform, Transfer functions, Hankel transform, Sampling theorem, Projection Radiography (Mammography, Fluoroscopy, Angiography etc), Nuclear Medical Imaging, Ultrasound Imaging, Magnetic Resonance Imaging.

UNIT 4: MEMS & BIOMEMS

Introduction, MEMS, micro system, sensor, actuator Material for MEMS Sensing and actuation Fabrication of MEMS, Material for MEMS, Sensing and actuation, Fabrication of MEMS and MEMS packaging.

UNIT 5: BIOSENSORS

Sensor architecture and Classification; Medically significant measurands, functional specifications of medical sensors; Sensor characteristics: linearity, repeatability, hysteresis, drift; Sensor models in the time & frequency domains. Sensors for physical measurands: strain, force, pressure, acceleration, flow, volume, temperature and biopotentials. Sensors for measurement of chemicals: Electronic eye,electronic nose and electronic tongue and their use in fermentations and breweries. Potentiometric sensors, ion selective electrodes, ISFETS; Amperometric sensors, Clark Electrode; Biosensors, Catalytic biosensors, Immunosensors.

References:

1. William R. Hendee, E. Russell Ritenour Medical Imaging Physics.

2. Jerry L. Prince, Jonathan M., Medical Imaging Signals and Systems. Pearson
3. Khandpur R.S., Hand book of Biomedical instrumentation, TMH.
4. Carr & Brown, Introduction to Biomedical Equipment,PHI.
5. J. G. Webster (Ed.): Medical Instrumentation - Application and Design; Houghton Mifflin Co., Boston, 1992.
6. R. Aston: Principles of Biomedical Instrumentation and Measurement, Merril Publishing Co., Columbus, 1990.
7. Manz and H. Becker, Eds. Microsystem Technology in Chemistry and LifeSciences Spronger-Verlag, New York, 1999.
8. Guyton and Hall, "Textbook of Medical Physiology", Elsever

BM4006 PROJECT AND PRODUCTION MANAGEMENT

Externals: 60Marks **L-T-P-C***

Internals: 40Marks **4-0-0-3**

Course Objective:

- To make students learn about holistic approach of Project Management
- To make students learn about optimizing Production to increase the return while reducing the risk
- This course aims at helping the students to learn operations management systems and analyze issues pertaining to management of productivity, technology and facilities.
- The objective of the course is to impart the concepts, tools & techniques in formulation and analysis of projects as well as in planning, scheduling & controlling of projects.

Course Outcomes:

1. After learning this, the students will be in the position to understand and practice the process of project management and its application in delivering successful IT projects.
2. Evaluate a project to develop the scope of work, provide accurate cost estimates and to plan the various activities.
3. After learning this, students understand and use risk management analysis techniques that identify the factors that put a project at risk and to quantify the likely effect of risk on project timescales.
4. Identify the resources required for a project and to produce a work plan and resources schedule.
5. The learner will have a deep knowledge of the fundamental theory and mathematical principles involved in the Learning Curve, Line Balancing, Forecasting, Material Requirement Planning, Capacity Management, Line Balancing, Inventory, Scheduling, Staffing and Control in order to optimize operating systems.
6. The learner will have a range of skills which can be applied to any production or service system. This module will also enhance the professional and technical skills of the student Competence.

Unit I:
Introduction: Project management: an overview, Project Selection: Project Identification and Screening, Project Appraisal: Part I, Project Appraisal: Part II, Project Selection. (6 modules)

Unit II:
Project Planning and Implementation: Development of Project Network, Project Representation, Consistency and Redundancy in Project Networks, **Project Scheduling:** Basic Scheduling with A-O-A Networks, Basic Scheduling with A-O-N Networks, Project Scheduling with Probabilistic Activity Times. Project Implementation: Project Monitoring and Control with PERT /Cost, Project Completion, Review and Future Directions. (8 Modules)

Unit III:
Production Management: Introduction to Production Systems and a Generalized Model of Production, Life cycle of a Production System and Major managerial Decisions, **financial evaluation of production related decisions,** Performance Measures of a Production System, Financial Evaluation of Capital Decisions, Decision Trees and evaluation of risk. (6 Modules)

Unit IV:
Product Design, Facility Location and Layout: Introducing New Products and Services, Product Mix Decisions, **Facility location and layout:** Plant Location, Process Layouts, Product Layouts and Assembly Line Balancing, Cellular Layouts, Layouts for Advanced Manufacturing Systems. (8 Modules)

Unit V:
Production Planning: Production Planning over medium term: Demand Forecasting, Aggregate Production Planning. Operational Decisions over Short term: .Inventory related Decisions, Material Requirements Planning and Scheduling of Job Shops. (8 Modules)

REFERENCE BOOKS:

1. Elements of Production Planning and Control / Samuel Eilon.

2. Modern Production/ operation managements / Baffa & Rakesh Sarin

3. Operations Management – S.N. Chary.

4. Inventory Control Theory and Practice / Martin K. Starr and David W. Miller.

5. Reliability Engineering & Quality Engineering by Dr. C. Nadha Muni Reddy and Dr. K. Vijaya Kumar Reddy, Galgotia Publications, Pvt., Limited.

6. Operations Management / Joseph Monks.

7. Project Management, Prasanna Chandra.

Rajiv Gandhi University of Knowledge Technologies

Basar, Nirmal – 504107

B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

IV YEAR II SEMISTER

Subject Type	Subject Code	Subject Name	L-T	P	C
Free Elective-II			4	-	3
Compulsory	EC4000	Comprehensive Viva			1
Compulsory	EC4800	Project			16
TOTAL					

List of Free-electives:

BM4501	FOUNDATIONS OF MANAGEMENT
BM4502	ENTREPRENEURSHIP AND NEW VENTURES
BM4503	INTELLECTUAL PROPERTY RIGHTS
BSBE4501	SUSTAINABLE TECHNOLOGY
BSBE4502	PHARMACEUTICAL TECHNOLOGY
BSBE4503	BIO MATERIALS
CH4504	Computational Fluid Dynamics

BM4501 **FOUNDATIONS OF MANAGEMENT**

Externals: 60Marks **L-T-P-C***

Internals: 40Marks **4-0-0-3**

Course Objective:

- This course enables the students to learn wide range of managerial concepts and equip them to handle the management assignment in the future.

Course Contents:

1. **Development of Management Thought:** Learning objectives, Concept of management, Scientific Management-Taylor, Henry Fayol contributions, Human Relations approach-Hawthorne experiments, Approaches to Management, Ethics in management.
2.
2. **Functions of Management:** Management Processes and function: Nature and description of management process, Managerial functions: Planning, Organizing, Directing, Coordinating and Controlling. Communication process, Theories of motivation and leadership, (14 Modules)

3. Human Resource Management: Nature and Scope of Human Resource Management, Functions of HRM, Industrial Relations. (7 Modules)

4. **Marketing Management:** Marketing Environment, Consumer Markets and Buyer Behaviour, Segmentation, NPD, PLC, Marketing Mix (4Ps), Channels of Distribution. Advertising and Sales Promotion, Personal selling, Public relations. (8 Modules)

5. **Production/Operation Management:** Planning and Design of Production and Operation Systems, Facilities Planning, Location, Layout and Movement of Materials, Materials Management and Inventory Control, Maintenance management, Statistical Quality Control, TQM and ISO Certification. (7 Modules)

Suggested Reference Books:

1. Weirich, Koontz & Aryasri, *Principles of Management,* TMH, New Delhi, (2004).
2. Paul Heresy & Ken Blanchard, *Management and Organizational behavior,* PHI, New Delhi, (1995)
3. Kotler Philip, *Marketing Management*, Prentice Hall of India (1997).

4. Luthans Fred, *Human Resource Management*, McGraw Hill, (1997).
5. Stephen Robbins, O*rganizational Behaviour Concepts, Controversies and Applications*.

BM4502 ENTREPRENEURSHIP AND NEW VENTURES

Externals: 60Marks **L-T-P-C***

Internals: 40Marks **4-0-0-3**

Course Objective:

- This course enables the students to learn wide range of managerial concepts and equip them to handle the management assignment in the future.

Course Objective:

This course has two basic objectives. The first is to teach effective entrepreneurial and general management practice from the perspective of the founder and stakeholders. The second is to apply the entrepreneurial perspective in order to approach business problems from a value creation framework.

Course Contents:

1. **Introduction to Entrepreneurship:** Learning objectives, Entrepreneurship in Indian Scenario and Future prospects, Emerging economies, Entrepreneurial traits, motivation and leadership (7Modules)

2. **Entrepreneurial Process:** Opportunity Identification, Idea Generation and Evaluation. (6 Modules)

3. **Business Model:** Business Plan, Business Models (Creating a business model with technology differentiators) (5 Modules)

4. **Financing Venture**: Funding, Valuation of a new company, Marketing, Company Growth, Acquisitions and Exit Strategies. (6 Modules)

5. **Building the Team and IPR:** Launching and managing venture, Human resource aspects. Intellectual Property and Corporate Law. (12 Modules)

Suggested Reference Books:

1. Kuratko & Hodgetts, *Entrepreneurship-Theory, Process Practice*, Thompson South-Western Publication, (2008).
2. Holt, *Entrepreneurship – New Venture Creation*, PHI Publication, (1992).
3. Kawasaki, *The Art of the Start*, Portfolio Publication, (2004).
4. Lusk & Harrison, *The Mouse Driver Chronicles: The True-Life Adventures of Two First-Time Entrepreneurs*, Perseus Books Group, (2002).
5. Dorf & Byers, *Technology Ventures: From Idea to Enterprise*, McGraw Hill Publication, (2010).
6. Kaplan, Startup: *A Silicon Valley Adventure*, Penguin Books, (2001).

BM4503 **INTELLECTUAL PROPERTY RIGHTS**

Externals: 60Marks **L-T-P-C***

Internals: 40Marks **4-0-0-3**

Course Objective:

- This course enables the students to learn wide range of managerial concepts and equip them to handle the management assignment in the future.

Course Objective: This course aims at helping the students to learn legalities of intellectual property to avoid plagiarism and other IPR relates crimes like copyright infringements.

Course Contents:

1. **Introduction to IPR:** Meaning of Intellectual Property, Nature of I.P, Protection of IP Rights, Kinds of I.P rights, International Conventions on Intellectual Property Rights-patent treaty 1970, GATT1994, TRIPS &TRIMS, International Organisation for Protection of IPR-WTO, WIPRO, UNESCO.

2. **Patent Rights:** Meaning of patent, commercial significance, Obtaining patent, patentable subject, rights and obligations of patentee, Registration of patents, compulsory licensing and licenses of rights, revocation.

3. **Industrial designs**: Definitions of Designs, Registration of Designs, rights and duties of proprietor of designs, piracy of registered designs.

4. **Introduction and significance of Trademarks**: Meaning of Trademark, purpose of protecting Trademarks, Registered Trademarks, procedure, passing off, assignment and licensing of Trademarks, Infringement of Trademarks.

5. **Nature of scope of Copy Right**: Subject matter of Copy Right, Right conferred by copyright publication, Board- Casting and telecasting, Computer programme, database right, Assignment and Transmission of Copyright, Infringement of copy right.

Suggested Readings:

1. Cornish.W.R, "Intellectual Property Patents", Copy Right and Trademarks and Allied rights, Sweet&Maxwell 1993.
2. P. Narayanan: Intellectual Property Law, Eastern Law House, 2nd edn 1997.
3. Roy Chowdhary, S.K. & Other:Law of Trademark, Copyrights, Patents and Designs, Kamal Law House, 1999.
4. Dr. G.B. Reddy,Intellectual Property Rights and the Law 5th Ed. 2005 GogiaLaw Agency.
5. B.L. Wadhera: Intellectual Property Law, Universal Publishers, 2nd Ed. 2000.

BSBE 4501 SUSTAINABLE TECHNOLOGIES

Externals: 60 Marks	L-T-P-C
Internals: 40 Marks	3-0-0-3

Course Objectives:
To give an overview of existing technologies and their associated problems. The main objective of the course is to stress on the need of innovation in development of sustainable technologies.

Course Outcome:
This paper sets out to discuss the commonalities that can be found for sustainable development. The commonalities include systemic or holistic thinking, the integration of different perspectives, skills such as critical thinking, diverse attitudes and values. Student will get the knowledge to resolve the environmental problems of the planet, work towards community-oriented problems with coherent and inferential problem solving skills.

UNIT 1: DRAW BACKS OF CURRENT TECHNOLOGIES

Environmental degradation, financial constraints, social issues with automation in technology, extinction of fossil fuels, risks involved in operations. Global environmental issues- Resource degradation, Climate change (Carbon credits and carbon trading, carbon foot print), Global warming, Ozone layer depletion, Regional and Local Environmental Issues.

UNIT 2: ENVIRONMENT REMEDIATION

Environment Impact Assessment (EIA) - Procedures of EIA in India, Physical and Chemical technologies for reclamation, Need for ecosystem restoration, Bioremediation.

Alternative Hirarchy Process (AHP), Selection of best technology using AHP, Alternative resources and technologies, resource recovery from waste, energy recovery from waste, Sustainable Development vs Environmental Engineering - Energy Issues.

UNIT 3: SUSTAINABLE TECHNOLOGIES

Sustainability - Introduction, Need and concept of sustainability; People, planet and profit; Social, environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Green technologies.

UNIT 4: BIOMIMICRY

Defining biomimicry, why biomimicry matters? Biomimicry examples - Bioplastics, biomaterials, bioluminescence for LED's, neural networks, swarm intelligence, aerodynamics for automobile engineering, DNA computing.

UNIT 5: BIOLOGICAL RESOURCES FOR SUSTAINABILITY

Organic Farming for sustainable agriculture, Microbial leaching of low grade mineral ores, Bioelectricity (Microbial fuel cells), Biomagnetism (for therapy), Biofuels (for energy), Microbial engineering for cleaning environmental pollution, biosynthesis of industrial products.

Reference:

1. *Perspectives on Sustainable Technology- M. Rafiqul Islam*

2. Sustainable Energy Consumption and Society- David L. Goldblatt

3. Sustainable development (energy, engineering and technologies, manufacturing and environment) - Chaouki Ghenai

4. Sustainability and Environmental Impact of Renewable Energy Sources - R. E. Hester, R. M. Harrison

5. Sustainable Natural Resources Management - Prof. Abiud Kaswamila.

6. Sustainable Communities Design Handbook - Woodrow W. Clark

7. Handbook of Bioplastics and Biocomposites Engineering Applications - Srikanth Pilla

8. Modeling & Imaging of Bioelectrical Activity: Principles and Applications (Bioelectric Engineering) - Bin He

9. Handbook of Swarm Intelligence: Concepts, Principles and Applications – YuhuiShi, Meng- Hiot Lim, Bijaya ketan Panigrahi.

10. DNA Computing and Molecular Programming - DNA 16 – Yasubumi sakkibara, yongli Mi

11. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.

12. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning .

13. Environment Impact Assessment Guidelines, Notification of Government of India, 2006

14. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998 .

15. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System

16. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.

17. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).

18. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios publication.

19. Biomimicry: Innovation Inspired by Nature by Janine Benyus.

BSBE 4502 PHARMACEUTICAL TECHNOLOGY

Externals: 60 Marks	**L-T-P-C**
Internals: 40 Marks	**3-0-0-3**

Course Objectives:

Pharmaceutical Technology course is designed to educate chemical engineer students and provide them with the skills required to work in the pharmaceutical field, with particular emphasis on the engineering aspects of drug manufacturing, pharmaceutical production, pharmaceutical development, and pharmaceutical operations.

Course Outcomes:

Upon completion of the program, students will be able to:

-Apply in-depth knowledge and practical skills for formulation and process manufacturing of chemical and biological drugs into a range of pharmaceutical dosage forms, ranging from tablets to injectables.

-Demonstrate that they have gained practical skills in instrumental analysis, clinical testing and quality control of drugs.

-Evaluate therapeutic management of diseases based on knowledge of drug design, pharmacokinetics and pharmacotherapy.

-Demonstrate their ability to solve problems and suggest pharmological interventions in health issues related to the local community.

-Demonstrate their ability to conduct healthcare related research.

-Demonstrate the acquired skills and knowledge expertise in communication and coordinate activites with other health providers and beneficiaries.

-Integrate the necessary knowledge and skills quickly into the industrial environment and to operate effectively in production processes.

-Understand the regulatory and quality compliance of pharmaceuticals in the process of drug development and manufacturing.

UNIT 1: PREFORMULATION STUDIES

Introduction, Consideration of physicochemical properties of new drug molecules for different dosage forms. Aqueous solubility, organic solubility, intrinsic solubility, methods of enhancement of solubility-surfactants, pH, co-solvency, solid dispersion, complexation. Techniques for the study of crystal properties and polymorphism - DSC, TGA, PXRD, Optical microscopy, hot stage microscopy.

UNIT 2: PHARMACEUTICAL EXCIPIENTS & POLYMERS

Factors affecting the selection of excipients, drug-excipient interactions, Study of cyclodextrins, ion exchange resins, film coating materials, super-disintegrants, directly compressible vehicles, surfactants and thickeners. Co-processed excipients. Excipient compatibility studies

Polymer classification-biodegradable, synthetic, semi-synthetic and natural polymers. Hydrogels and their applications.

UNIT 3: FORMULATION TECHNOLOGY

Tablet technology: Compression, consolidation, decompression, compaction at high loads, forces distribution during compression, compaction profiles, measurement of forces during compression, energy involved in compaction, properties of granules of compression, influence of compression force on the properties of tablets.

Capsule technology: Manufacturing equipment and machinery used in capsule technology. Formulation and evaluation of hard gelatin capsules and soft gelatin capsules.

Parenterals technology: Manufacturing of LVP, SVP, Sterilization and sterility testing of parenterals, GMP & c GMP regulations of parenteral technology.

UNIT 4: STABILITY TESTING - DRUGS AND DOSAGE FORMS

Solid state drug stability, dosage form stability, accelerated stability testing, shelf life calculations, strategies for prolonging shelf life. Effect of packaging materials on dosage form stability. Basic principles of ICH, stability testing of new drug substance and formulations, photostability testing and oxidative stability, role of containers in stability testing. WHO stability guidelines.

UNIT 5: CONCEPTS OF CONTROLLED RELEASE DRUG DELIVERY SYSTEMS

Introduction, concept, advantages & disadvantages. Factors to be considered for designing controlled release dosage forms. Dissolution, Diffusion, Combination of dissolution and diffusion controlled drug delivery systems. Classification of rate-controlled drug delivery systems. Rate-programmed release, activation-modulated and feedback regulated drug delivery systems. Effect of system parameters on controlled drug delivery. Hydrodynamically balanced systems, Osmotic pressure controlled, pH controlled, ion exchange controlled systems

REFERENCE BOOKS

1) Lieberman HA and Lachman L. Pharmaceutical Dosage Forms: Tablets. Vol. I, II and III, Marcel Dekker, New York. Latest Edition.

2). Avis KE, Lachman L and Lieberman HA, Pharmaceutical Dosage Forms: Parenterals. Volume I and II, Marcel Dekker, New York. Latest Edition.

3) Robinson and Lee, Controlled drug delivery: Fundamentals and applications, Marcel Dekker.

4) Carstensen, Pharmaceutical principles of solid dosage forms, CRC.

5) Ray and Weller, Handbook of Pharmaceutical Excipients, Pharmaceutical Press.

BSBE 4503 **BIOMATERIALS**

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **3-0-0-3**

Course Objectives:

After successfully completing this course, students will be able to:

1. Understand the fundamental principals in biomedical engineering, material science and chemistry, and how they contribute to biomaterial development and performance.
2. Understand the material selection and structure-function relationships

3. Lists the different strategies to modify and/or design materials that are biocompatible.

Course Outcomes

On completion of this course students should be able to:

- Demonstrate in-depth knowledge of the mechanical and biological properties of both natural and synthetic biomaterials and thereby implicate its behavior with biological system.

- Describe the role of adsorbed proteins and cells in the tissue response to biomaterials.

- Demonstrate an understanding of the host response to orthopedic biomaterials and be able to compare the responses to different materials.

- Describe the methods of testing for biomaterials biocompatibility.

- Distinguish the events that lead to the degradation of materials in the biological environment.

- Demonstrate an understanding of implant failure from a biological perspective.

-Appreciate the complex mechanical and biological interactions between biomaterials and biological systems

-Demonstrate an in-depth knowledge of the application of biomaterials (both natural and synthetic) in orthopedics, dental, cardiovascular, drug delivery and various system repairing activities of a human body.

UNIT 1. INTRODUCTION TO THE BACKGROUND CONCEPTS OF BIOLOGY, BIOCHEMISTRY AND MEDICINE.

Concepts of cells, proteins and their interaction with the biomaterial, Structure and properties of different classes of biomaterials; Interactions of materials with the human body; Criteria for selection of biomaterials for specific medical applications, Concepts of Biocompatibility, mechanical properties of biomaterials, corrosion and biodegradation, evaluation of biomaterials.

UNIT 2. METALS AND ITS COMPOSITES.

Surface interaction with the cells; Classes of metals & metal composites; Applications of metals & metal composites; Biocompatibility testing's and evaluation of metals and its composites.

UNIT 3. CERAMICS AND ITS COMPOSITES.

Surface interaction with the host cells; Classes of Ceramics and its composites; Applications of Ceramics and its composites; Biocompatibility testing's and evaluation of Ceramics and its composites.

UNIT 4. POLYMERS AND ITS COMPOSITES.

Surface interaction with the cells, classes of polymers and its composites; Applications of polymers and its composites; Biocompatibility testing's and evaluation of polymers and its composites.

UNIT 5. BIOMEDIACAL APPLICATIONS OF BIO MATERIALS.

Nanostructure biomaterials, Orthopedic implants, dental implants, vascular grafts, ocular materials, drug delivery carriers, introduction to tissue regeneration scaffolds.

.**Texts & References**

- Ratner B, Hoffman A. et al. Biomaterials science: An introduction to materials in medicine, Academic Press, 2004
- Fredrick H. Silver: Biomaterials, Medical Devices & Tissue Engineering: An integrated approach. Chapman & Hall, 1994

CH4504 COMPUTATIONAL FLUID DYNAMICS

Externals: 60 Marks **L-T-P-C**

Internals: 40 Marks **4-0-0-3**

Course Objective:

- To be able to apply to apply the conservation laws to fluids in motion under different conditions
- To learn modeling of fluid flow under different conditions
- To learn how to convert differential equations to difference equations and to learn grid generation methods
- To simulate the model

Unit-1 Conservation Laws And Turbulence Models

Governing equations of fluid flow and heat transfer –mass conservation, momentum and energy equation, differential and integral forms, conservation and non-conservation form. Characteristics of turbulent flows, time averaged Navier Strokes equations, turbulence models-one and two equation, Reynolds stress, LES and DNS

Unit-2 Finite Differnce Approximation

Mathematical behaviour of PDE, finite difference operators, basic aspects of discretization by FDM, explicit and implicit methods, error and stability analysis

Unit-3 Finite Volume Method

Diffusion problems – explicit and implicit time integration; Convection-diffusion problems – properties of discretisation schemes, central, upwind, hybrid, QUICK schemes; Solution of discretised equations.

Unit-4 Flow Field Computation

Pressure velocity coupling, staggered grid, SIMPLE algorithm, PISO algorithm for steady and unsteady flows

Unit-5 Grid Generation

Physical aspects, simple and multiple connected regions, grid generation by PDE solution, grid generation by algebraic mapping.

Text Books:

1. Computational Fluid Dynamics: The Basics with Applications, Anderson, J. D., McGraw-

Hill, 1995.

2. Computational Techniques for Fluid Dynamics, Fletcher, C. A. J., Springer Verlag, 1997.

References:

1. An Introduction to Computational Fluid Dynamics:The Finite Volume Method, Versteeg, H.K. and Malalasekera, W.,Pearson Education Ltd., 2007.
2. Computational Fluid Dynamics, Chung T.J , Cambridge University Press 2003.
3. Computational Fluid Flow and Heat Transfer, Muralidhar, K., and Sundararajan, T., Narosa Publishing House, New Delhi, 2001.
4. Numerical heat transfer fluid flow, Subas, V. Patankar Hemisphere Publishing Corporation, 1980.

EC4800 **PROJECT**

Externals: 60 Marks **L-T-P-C**

Internals: 40 Marks **0-0-0-12**

Student has to do literature review on the chosen/allotted area of project work and must submit a report.

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Rajiv Gandhi University of Knowledge and Technology
Basar, Mudhole, Adilabad – 504107
B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

Regulations -2018

B16 Batch Course Structure for B.Tech

Electronics and Communications Engineering (RGUKT-Basar)

I SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	MA1101	Mathematics – I (Matrix theory and Calculus)	BSC	3	1	0	4	4
2	CY1001	Chemistry	BSC	3	1	0	4	4
3	ME1001	Engineering workshop	ESC	2	0	0	2	2
4	HS1101	Communication Skills-I	HSMC	2	0	0	2	0
5	CS1001	Programming for Problem Solving	ESC	3	0	0	3	3
6	CY1601	Chemistry Lab	BSC	0	0	3	3	1.5
7	ME1601	Engineering workshop Lab	ESC	0	0	2	2	1
8	CS1601	Programming for Problem Solving Lab	ESC	0	0	4	4	2
Total				13	2	9	24	17.5
Induction Program (Non-credit)- Syllabus as per AICTE guide lines								

II SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EE1002	Basic Electrical Engineering	ESC	3	1	0	4	4
2	MA1201	Mathematics – II (Differential equations, Vector calculus)	BSC	3	1	0	4	4
3	PH1001	Physics	BSC	3	1	0	4	4
4	CE1001	Engineering Graphics	ESC	1	0	4	5	3
5	HS1001	English	HSMC	2	0	0	2	2
6	BM0005	Constitution of India	MC	2	0	0	2	0
7	HS1201	Communication Skills – II	HSMC	2	0	0	2	0
8	EE1602	Basic Electrical Engineering lab	ESC	0	0	2	2	1
9	PH1601	Physics Lab	BSC	0	0	3	3	1.5

10	HS1601	English Language Lab	HSMC	0	0	2	2	1
Total				16	3	11	30	20.5

III SEMESTER

Sl. No.	**Course Code**	**Course Title**	**Course Category**	**Hours per week**			**Total contact hours**	**Credits**
				L	**T**	**P**		
1	EC2101	Digital Electronic Circuits	PCC	3	0	0	3	3
2								
3	EC2102	Electronic Devices and Circuits	PCC	3	1	0	4	4
4	EC2103	Signals and Systems	PCC	3	1	0	4	4
5	EC2901	Electronics mini Project-I	PJT	0	0	2	2	1
6	MA2101	Mathematics-III (Linear algebra, Complex analysis)	BSC	3	1	0	4	4
7	HS2101	Essence of Indian Traditional Knowledge	MC	2	0	0	2	0
8	BS2101	Environmental Science	MC	3	0	0	3	0
9	EC2701	Digital Electronic Circuits lab	PCC	0	0	2	2	1
10	EC2702	Electronic Devices and Circuits lab	PCC	0	0	2	2	1
Total				16	3	6	26	18

IV SEMESTER

Sl. No.	**Course Code**	**Course Title**	**Course Category**	**Hours per week**			**Total contact hours**	**Credits**
				L	**T**	**P**		
1	EC2201	Analog Circuits	PCC	3	0	0	3	3
2	EC2202	Control systems	PCC	3	0	0	3	3
3	EC2203	Electromagnetic Waves	PCC	3	0	0	3	3
4	EC2204	Probability Theory and Stochastic Processes	PCC	3	1	0	4	4
5	CS2205	Object Oriented Programming	ESC	3	0	0	3	3
6	EC2902	Electronics mini Project-II	PJT	0	0	2	2	1
7	BM0007	Managerial Economics and Financial analysis	HSMC	3	0	0	3	3
8	EC2801	Analog Circuits lab	PCC	0	0	2	2	1

9	CS2804	Object Oriented Programming lab	ESC	0	0	2	2	1
Total				18	1	6	25	22

V SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EC3101	Analog and Digital Communications	PCC	3	0	0	3	3
2	EC3102	Computer Architecture	PCC	3	0	0	3	3
3	EC3103	Digital Signal Processing	PCC	3	0	0	3	3
4	EC3104	RF and Microwave Engineering	PCC	3	0	0	3	3
5	EC3105	VLSI Engineering	PCC	3	0	0	3	3
6		Open Elective-1 (Preferably Numerical Methods)		3	0	0	3	3
7	EC3701	Analog and Digital Communications lab	PCC	0	0	2	2	1
8	EC3702	Digital Signal Processing lab	PCC	0	0	2	2	1
9	EC3703	RF and Microwave Eng. Lab	PCC	0	0	2	2	1
10	ECSEM	Technical Seminar (on recent trends)	PJT	0	0	2	2	1
Total				18	0	8	26	22

VI SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EC3201	Digital System Design	PEC	3	0	0	3	3
2	EC3202	Micro-Controllers and Interfacing	PCC	3	0	0	3	3
3	EC_	Pattern Recognition	PEC	3	0	0	3	3
4	CS3203	Operating Systems	ESC	3	0	0	3	3
5	BM0003	Operations Research (Management Dept)	HSMC	3	0	0	3	3
6	EC3801	Digital Systems Design and VLSI Lab	PCC	0	0	2	2	1
7	EC3802	Micro-Controllers lab	PCC	0	0	2	2	1

8	ECP01	Mini Project	PJT	0	0	4	4	2
9	ECCV-I	Comprehensive Viva-I						0
10	ECP02	Summer Internship						1
Total				15	0	8	23	20

VII SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EC_	Signal Processing stream elective	PEC	3	0	0	3	3
2	EC_	Communications stream elective	PEC	3	0	0	3	3
3	EC_	Embedded systems stream elective	PEC	3	0	0	3	3
4	BM0010	Professional Law and Ethics	HSMC	3	0	0	3	3
5	ECP03	Project Stage-I	PJT	0	0	6	6	3
6	CS4101	Computer Networks	ESC	3	0	0	3	3
7	CS4701	Computer Networks lab	ESC	0	0	2	2	1
Total				15	0	8	23	19

VIII SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EC_	Program Elective-4 (Preferably course on Antennas)	PEC	3	0	0	3	3
2	EC_	Open Elective-3	PEC	3	0	0	3	3
3		Open Elective-4		3	0	0	3	3
4		Open Elective-5		3	0	0	3	3
5	ECP04	Project Stage-II	PJT			16	16	8

6	ECCV-II	Comprehensive viva-II						0
Total				12	0	16	28	20

B16 Batch Course Curriculum for B.Tech Electronics and Communications Engineering (RGUKT-Basar)

I SEMESTER

MA1101 **MATHEMATICS - I**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **4-0-0-4**

Course Objectives:

10. To give a thorough explanation of real sequences and series.
11. To introduce the concepts of Euclidean space and the behavior of functions in them.
12. To emphasize the applications of differentiation on real functions and their geometrical inferences.
13. Introduction to Numerical analysis.
14. To Introduce Fourier series and it's applications.

Course Outcomes:

At the end of the course student will be able to

2. Explain concept of limit of function of two variables
3. Understand the two path criterion to show that a limit does not exist and apply it to solve problems about limits
4. Memorize definition of partial derivative and illustrate geometric meaning withthe aid of sketches.
2. Provide geometrical meaning of second partial derivative with respect to onevariable
3. Calculate directional derivatives and gradients &Apply it to solve problems involving steepest ascent and normal vectors to level curves.
4. Apply the method of Lagrange Multipliers to solve such constrained optimization problems.
5. Understand & apply various theorems like, Rolle's theorem.Lagrange's Mean value theorem, Cauchy Mean Value theorem in Calculus.
6. Understand & Apply various tests for convergence of sequences & series

7. Find the find the fourier series of periodic functions
8. Find the Fourier sine and cosine series for functions defined on an interval.
9. Use to numerical methods in modern scientific computing
10. Find the roots of various types of equations using Numerical methods & find the area under the curve using Trapezoidal Rule, Simpson $\frac{1}{3}$ Rule, Simpson $\frac{3}{8}$ Rule

UNIT-I

Sequence: Definition of sequence, convergence, limit of a sequence, divergence, oscillation, bounded and monotonic sequences, Bounded sequences,Sandwich theorem, Algebra of limits, L'Hospital Rule in sequences, subsequences and its limit.

Series: Infinite series, partial sum, convergence, divergence, oscillation, Geometric series, Telescoping series, Algebra of Limits, n^{th}- term test, Comparison test, Comparison test (Limit Form), Integral test, D'Alembert's Ratio test, Cauchy's Root test, Alternating series, Leibnitz's Rule, Absolute convergence, Conditional convergence, Power series, Radius of convergence for a power series.

UNIT-II

Differential calculus: Rolle's theorem, Lagrange's mean value theorem, Cauchy's Mean-value theorem, Taylor's Theorem and Expansion, Maclaurin's Theorem and Expansion, Indeterminate forms and application of L'Hospital Rule. Radius of curvature, Envelope, Increasing and decreasing functions, concavity, convexity and point of inflexion, Asymptotes-Curve Tracing(Sketching)

UNIT-III

Functions of Several Variable Calculus:
Definition of continuity and differentiability in single variable, n-dimensional Euclidean space, Neighborhood of a point in n-dimensional Euclidean space, Functions in n-variables, Functions in 2 & 3 variables, Interior points, Boundary points, open and closed regions,Limit and continuity, Two-path test, Discontinuities, Partial Differentiation, Clairaut's theorem(for mixed Partial Derivatives), Laplace equation, Homogeneous functions , Euler's theorem for Homogeneous functions, Differentials and derivatives, Derivatives of composite functions, Chain Rule, Jacobians, Taylor's Theorem, Maxima and minima, Lagrange's method of multipliers.

UNIT-IV:

Fourier Series:
Definition of Fourier Series, Fourier Series representation of function, Limit of Convergence of Fourier Series, Even & Odd functions, Gibb's Phenomenon, Sine and Cosine Series, Limit of Convergence of Sine & Cosine Series. Integration and Differentiation of Fourier Series, Bessel's Inequalities, Parseval's Theorem.

UNIT-V

Numerical Methods:
Introduction: True value, Approximate Value, Error, Error percentage, Application of Numerical Analysis in various fields.
Numerical Analysis in solving Algebraic equations: Algebraic equations, Transcendental equations, Bisection Method, Regula -Falsi Method, Newton-Raphson Method.
Numerical Integration: Trapezoidal Rule, Simpson $\frac{1}{3}$ Rule, Simpson $\frac{3}{8}$ Rule

Text Books:

5. Thomas Calculus, Maurice D.Wier, Joel Hass Eleventh Edition, Pearson Education ,2008

6. R.K. Jain & S.R.K.Iyengar, Advanced Engineering Mathematics, Third Edition, Narosa publications, 2007.

7. Erwin Kreyszig, Advanced Engineering Mathematics, 8^{th} Edition, John Wiley & Sons Ltd 2006.

Suggested References:

2. B.S. Grewal and J.S. Grewal, "Higher Engineering Mathematics",(40th Edition), Khanna Publishers,2007
3. S.S. Sastry ,Introductory Methods of Numerical Analysis ,Third Edition, Prentice Hall India

CY1001 **CHEMISTRY**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-1-0-4**

Unit I: Spectroscopy

Introduction to spectroscopy, electromagnetic radiations, different types of spectroscopy, principle of spectroscopy, spectrophotometer Microwave spectroscopy: principle, microwave spectra of diatomic molecules, selection rules for microwave spectra, applications of microwave spectroscopy: determination of bond length, dipole moment measurement, determination of isotopic mass of an element. Infrared spectroscopy: introduction and principles of IR, types of vibrations: bending and stretching, Hooke's law for stretching vibrations, characteristic frequencies of common functional groups, IR instrumentation, interpretation and applications of IR spectrum with examples.

Ultra-violet spectroscopy: Introduction and principle of UV spectroscopy, color interpretation with VBT and MOT, types of electronic transitions, selection rules, chromophores and auxochromes with examples, conjugation effect, absorption and intensity shifts, applications of UV spectroscopy.

Unit II: Chemical kinetics

Complex reactions: definition and classification of complex reactions, definition of reversible reactions with examples, rate law derivation for reversible reactions. Consecutive reactions: definition, rate law derivation and examples of consecutive reactions.Parallel reactions: definition, rate law derivation and examples of parallel reactions.Steady-state approximation: introduction, kinetic rate law derivation by applying steady state approximation in case of the oxidation of NO and pyrolysis of methane. Chain reactions: introduction, types and mechanism of chain reactions, stationary and non-stationary chain reactions with examples, deriving the kinetic rate equation using a general chain reaction. Photochemical reactions: introduction, Stark-Einstein law of photochemical equivalence, photophysical processes: IC, ISC, fluorescence and phosphorescence with examples, kinetic rate law derivation incase of photochemical decomposition of HI and photochemical combination of H_2 and Br_2.

Unit III: Electrochemistry

Types of electrodes: introduction, metal-metal ion electrodes, metal-insoluble salt-anion electrodes, calomel electrode, gas-ion electrodes, hydrogen and chlorine electrodes, oxidation-reduction electrodes, amalgam electrodes.

Types of cells: classification into chemical and concentration cells, chemical cells with transference and without transference, classification of concentration cells into electrolyte and electrode concentration cells, electrolyte concentration cells with and without transference, amalgam and gas concentration cells, examples for these cells.

EMF and applications of EMF: determination of pH, determination of the valency of the ions, potentiometric titrations. pH: definition of pH and determination of pH by various methods, acid-base titrations. Thermodynamic data: enthalpy and entropy of cell reactions, Gibbs-Helmholtz equation and applications.

Unit IV: Corrosion and its prevention

Mechanism of Dry and wet corrosion (rusting of iron), Types of corrosion, galvanic corrosion, stress corrosion, pitting and crevice corrosion. Factors affecting corrosion, preventive measures (proper design, Cathodic and Anodic protection, Electroplating, tinning, galvanizing.

Unit V: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecules like Aspirin, Ibuprofen.

Unit VI: Phase Rule:

Terminology, one component system (H_2O system, S- system and CO_2 – system), two components system, Cooling curves, simple eutectic system (Pb – Ag), system with congruent melting point (Zn – Mg).

Unit VII: Engineering Materials:

Polymers: Types of Polymerization (Chain & Step growth). Plastics: Thermoplastic & Thermo setting resins; Preparation, properties,engineering applications of PVC, Teflon and Bakelite.

Lubricants: Classification with examples-Characterstics of a good lubricant & mechanism of lubrication (thick film, thin film and extreme pressure) –properties of lubricants: viscosity, Cloud point, flash and fire points.

Refractories: Classification, characteristics of a good refractory and applications.

Nanomaterials: Introduction, preparation by sol-gel & chemical vapour deposition methods. Applications of nanomaterials.

Refer Books

3. Engineering Chemistry, Jain & Jain
4. Engineering Chemistry, Shashi Chawla
5. Chemistry for Engineers, B. K. Ambasta
6. Engineering Chemistry, H. C. Srivastava

ME1001 **Engineering Workshop**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **2-0-0-2**
Course Objectives:

3. To understand the basic manufacturing process of producing a component by casting, forming plastic molding, joining processes, machining of a component either by conventional or by unconventional processes.
4. To understand the advanced manufacturing process of additive manufacturing process.

Course Outcome:

3. Students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Module – 1:*Metal Casting*: Introduction, Tools, Types of Patterns, Pattern Materials, Types of casting – Sand, Die and other casting processes and Applications

Module – 2:*Metal Forming*: Introduction, Classification, Types of Bulk and sheet metal forming and Applications.

Module – 3:*Powder Metallurgy*: Introduction, Powder production methods, Compaction, Sintering, Secondary operations and Applications.

Module – 4:*Joining:* Types of Joining, Introduction to Welding, Brazing and soldering, Arc, Solid state welding processes.

Module – 5:*Conventional Machining processes*: Introduction to machining operations; Lathe operations, Drilling, Milling and Grinding.

Module – 6:*Unconventional Machiningprocesses*.

Module – 7:*CNC Machining and Additive manufacturing*

Text Books:

(i) Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

(ii) Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

Reference Books

(i)Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.

(ii) Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

(iii) Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

HS1101 **COMMUNICATION SKILLS- I**

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **2-0-0-0**

Objectives:

4. To make the students efficient communicators via experiential learning.
5. To enhance learners' analytical and creative skills, so that they will be capable to address a wide variety of challenges in their professional lives.
6. To help learners to improve the leadership qualities and professional etiquette
7. To expose learners to an effective communicative environment.

SYLLABUS:

Unit I – Introduction to communication

Introduction – Importance of Communication Skills – Definition – Scope and Nature – Verbal and Nonverbal communication

Unit II – Reading Skills

Reading Comprehension of unseen passage – Prose – News Paper Reading and Analysis (Editorial)

Unit III - Grammar

3. Parts of Speech

4. Subject and predicate
5. Articles – Determiners
6. Conjunctions (Linkers; connectors; cohesive devices)
7. Verbs – Transitive and Intransitive - Finite and Infinite - Regular and Irregular - Modals
8. Tenses
9. Prepositions/Prepositional verbs
10. Adverbs – types and their order in sentences
11. Adjectives
12. Including Degrees of Comparison and also Quantifiers

Unit IV – Enhancing Vocabulary

Developing Professional vocabulary – Using Dictionary: Spelling – Grammar and Usage

Unit V - Composition

Paragraph – Essay - Expansion - Describing the Pictures – Giving Directions – Situational Dialogue writing – Social and Professional Etiquette – Telephone Etiquette

OUTCOMES:

Students will be able to:

4. develop interpersonal communication, small group interactions and public speaking.
5. exercise the writing assignments, precise writing for informational, persuasive and creative purposes.
6. apply right form of structural usage of sentences in their written and oral communication.
7. develop confidence and skills related reading comprehension.
8. improve a logical framework for the critical analysis of spoken, written, visual and mediated messages upon a diverse platform.
9. demonstrate the ability to apply vocabulary in practical situations.

Suggested References:

4. Joseph Mylal Biswas book of English Grammar
5. R. Murphy -Cambridge Press
6. Wren and Martin
7. The Good Grammar book by OUP
8. Communication skills by M. Raman and Sangeeta Sharma
9. How to Win Friends and Influence People by Dale Carnigie
10. How to Read and Write Better by Norman Lewis
11. Better English by Norman Lewis
12. Use of English Collocations by OUP
13. www.humptiesgrammar.com

14. www.bbcactiveenglish.com
15. www.gingersoftware.com
16. www.pintest.com

CS1001 PROGRAMMING FOR PROBLEM SOLVING

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **3-0-0-3**

Objectives:

4. To introduce the basic concepts of Computing environment, number systems and flowcharts
5. To familiarize the basic constructs of C language – data types , operators and expressions
6. To understand modular and structured programming constructs in C
7. To learn the usage of structured data types and memory management using pointers
8. To learn the concepts of data handling using pointers

Detailed Contents:

UNIT-I: Introduction to Programming & Arithmetic expressions and precedence(8 Lectures)

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - (1 lecture).

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm:

Flowchart/Pseudocode with examples. (1 lecture)

From algorithms to programs; source code, variables (with data types) variables andmemory locations, Syntax and Logical Errors in compilation, object and executable code- (2 lectures) Arithmetic expressions and precedence (2lectures).

UNIT-II: Conditional Branching , Loops & Arrays(12 Lectures)

Writing and evaluation of conditionals and consequent branching (3 lectures) Iteration and loops (3 lectures)

Arrays (1-D, 2-D), Character arrays and Strings(6 lectures)

UNIT-III: Function & Basic Algorithms(11 Lectures)

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference(5 lectures)

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)(6 lectures)

UNIT-IV: Recursion &Structure(9 lectures)

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.(5 Lectures) Structures, Defining structures and Array of Structures(4 lectures)

UNIT-V: Pointers & File handling(7 lectures)

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

File handling (only if time is available, otherwise should be done as part of the lab)

Suggested Text Books

4. Byron Gottfried, Schaum's Outline of Programming with C,McGraw-Hill
5. E. Balaguruswamy, Programming in ANSI C, TataMcGraw-Hill

Suggested Reference Books

4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.

Course Outcomes:

4. Formulate simple algorithms for arithmetic and logical problems.
5. Translate the algorithms to programs (in c language).
6. Test and execute the programs and correct syntax and logical errors.
7. Implement conditional branching, iteration and recursion.
8. Decompose a problem into functions and synthesize a complete program using divide and conquer approach.
9. Use arrays, pointers and structures to formulate algorithms and programs.
10. Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
11. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

CY1601 ENGINEERING CHEMISTRY LABORATORY

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-3-1.5**

Course Objectives:

6.To learn the preparation of organic compounds in the laboratory
7.To estimate the hardness and alkalinity of the given sample of water
8.To understand the Job's method for determining the composition
9.Learns how to use the pH meter and polarimeter
10. Synthesis of a pharmacutically active drug

4. **Synthesis**
4. Synthesis of soap from cheap oil.
5. Synthesis of Thiokol rubber

5. **Volumetric analysis**
4. Estimation of alkalinity of water
5. Estimation of total hardness of water by EDTA method

6. **Job's method**
5. Determination of composition of Ferric-Thiocyanate complex by Job's method

7. **pH meter**
5. Estimation of the strength of a weak acid by pH metry

8. **Polarimeter**
5. Determination of specific rotation of sucrose by polarimeter

9. **Synthesis of Aspirin Drug (NSAID)**

Course Outcomes:

Minimum knowledge on basic synthesis, quantitative and qualitative analysis is being imparted

Reference books:

5. College Practical Chemistry by V K Ahluwalia, Sunita Dhingra, Adarsh Gulati
6. Practical Engineering Chemistry by K Mukkanti
7. A Text Book of Engineering Chemistry: by Shashi Chawla
8. Essentials of Experimental Engineering Chemistry by Shashi Chawla
9. Comprehensive Practical Organic Chemistry – Preparation and Quantitative analysis byV K Ahluwalia, Renu Aggarwal

ME1601 ENGINEERINGWORKSHOP LABORATORY

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Outcomes: Upon completion of this laboratory course

4. Students will be able to fabricate components with their own hands.

List of Experiments:

1. **Fitting –** Step and V Fit

2.**Carpentry** – Half lap joint and Dove tail joint

3. **House Wiring**– Series, Parallel, Staircase and Godown wiring

4**. Tin Smithy**– Tray and Cylinder

5. **Welding** – Bead formation, Butt and Lap joint welding

6**. Foundry**– Mold preparation with Single piece and Split piece pattern

7. **Machining** – Plain turning, Facing, Step and Taper turning

8. **Plastic molding** – Demo

9. **WIRE EDM, CNC, 3D Printer** – Demo

CS1601 **Programming for Problem Solving lab**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-4-2**

Course Objectives

6. Understand the fundamentals of programming in CLanguage.
7. Write, compile and debug programs inC.
8. Formulate solution to problems and implement inC.
9. Effectively choose programming components to solve computingproblems

Detailed Contents:

List of Tutorials/Experiments:

Week 1

Tutorial 1: Problem solving using computers:

Lab1: Familiarization with programming environment

Week 2

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions

- Write a C program to find the area of a circle using the formula: Area = PI *r2
- Write a C program to find the area and volume of sphere.
  (Formula are: Area =4*PI*R*R Volume =4/3*PI*R*R*R.)
- Write a C program to convertcentigradeinto Fahrenheit.
  (Formula: C=(F-32)/1.8.)
- Write a C program to read in twointegersand display one as a percentage of the other. Typically your output should looklike 20 is 50.00% of 40 assuming that the input numbers where 20 and 40. Display the percentage correct to 2 decimal places.

Week 3

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

4. Write a C program to find the maximum from given threenos.
5. Write a C program to find that the accepted no is Negative, Positive orZero.
6. Write a program which reads two integer values. If the first is lesser print the message **“up”**. If the second is lesser, print the message **“down”** if they are equal, print the message **“equal”**if there is an error reading the data, print a message containing the word**“Error”.**
7. Write a C program that prints the given three integers in ascending order using if –else.
8. Given as input three integers representing a date as day, month, year, print the number day, month and year for the next day's date. Typical input: “28 2 1992” Typical output: “Date following 28:02:1992 is29:02:1992”

Week 4 & 5

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series

3. Write a C program to find the sum of first 100 odd nos. and even nos.
4. Write a C program to display first 100 primenos.
5. Write a C program to read in a three digit number produce followingoutput

   (Assuming that the input is 347) 3 hundreds, 4 tens, 7 units

6. Write a C program to display Fibonacciseries
7. Write a C program to calculate the following i.sum=1-x2/2!+x4/4!-x6/6!+x8/8!-x10/10!+… ,

   ii.sum=x-x3/3!+x5/5!. ,

   iii.sum=1+x/1!+x^2/2!+x^3/3!. ,

8. Write a C program to find the roots of a Quadraticequation.

Week 6

Tutorial 5: 1D Arrays: searching, sorting:

Lab 5: 1D Array manipulation

3. C program that reads N integer numbers and arrange them in ascending order using BubbleSort
4. C program that reads N integer numbers and arrange them in ascending order using selectionSort
5. C program that reads N integer numbers and arrange them in ascending order using insertion Sort
6. C program that reads N integer numbers and arrange them in ascending order using MergeSort

Week 7

Tutorial 6: 2D arrays and Strings

Lab 6: Matrix problems, String operations

4. Write a C program to perform the basic Matrixoperations
   a. Addition ii) Subtractioniii)Multiplicationiv)Transpose.
5. Write a C program to determine if the given string is apalindrome or not
6. Write a C program to count the lines, words and characters in a given text
7. Write a C program to search a word in a given sentence.

Week 8

Tutorial 7: Functions, call by value:

Lab 7: Simple functions

2. Write a C Function for the followingtask
   a. Calculating Factorial
   b. Find value of a given Fibonacciterm
   c. Swapping the values of twovariable

3. Write a C program that uses functions to performthe followingoperations:
   a. To insert a sub-string in to a given main string from a given position.
   b. To delete n Characters from a given position in a given string.

Week 9

Tutorial 10: Recursion, structure of recursive calls

Lab 10: Recursive functions

3 Write the following recursive CFunction

i)Factorial of a givennumber

ii)Nth Fibonaccinumber

iii)Reverse of a givenString

iv)Reverse of a givenNumber

Week10

Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

6. Write a C program to maintain a record of "n" student detailsusing an array of structures with four fields (Roll number, Name, Marks, and Grade). Assume appropriate data type for each field. Print the marks of the student, given the student name asinput.
7. Define structure called cricket that will describe the information player name, team name,batting aveg.Using cricket ,declare an array player with 10 elements and write program to read information about all 10 players and print team wise list containing names of the player with their battingavg
8. Write a program using pointers to compute the sum of all elements sorted in anarray
9. Write a program to print the elements of a structure usingpointers.

Week11

Tutorial 12: File handling

Lab 12: File operations

6. Write a C program that creates an Employee text file? RecordsAre empid, empname,

designation, qualification, salary, experience, Research work, address, cityphone?

7. Write a C program that manipulates the above text file. The program must implements the operation to modify a record, delete a record and append newrecords

Course Outcomes

4. Choose appropriate data type for implementing programs in Clanguage.
5. Design and implement modular programs involving input output operations,decision making and loopingconstructs.
6.
7. Implement search and sort operations onarrays.
8. Apply the concept of pointers for implementing programs on dynamic memory management and stringhandling.
9. Design and implement programs to store data in structures andfiles.

Suggested Books:

6. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
7. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill Suggested Reference Books
8. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

II SEMESTER

EE1002 BASIC ELECTRICAL ENGINEERING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-1-0-4**

Course Objectives

9. To explain the basic concepts and laws of DC and AC electrical networks and solve them using mesh and nodal analysis techniques.
10. To introduce students with the fundamental concepts in graph theory.
11. To analyse circuits in time and frequency domain.
12. To explain concepts of driving point and transfer functions, poles and zeroes of network function and their stability.
13. To synthesize the network using passive elements.
14. To analyse the transformers and coupled circuits.
15. To analyse the DC and AC generators & motors with applications.

UNIT-1

Introduction of Networks: Mechanism of electrical energy flow through the conductor and basic ohm's law, passive lumped R, L, C's and ohm's law, types of elements, sources, Kirchhoff's laws, Nodal and Mesh Analysis Techniques, Equivalent circuits with respect to passive R, L, C's, equivalent circuits with respect to active sources, source transformation technique, Power calculation by tellegen's theorem.

Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation, Duality, Milliman's and Tellegen's theorem as applied to AC & DC circuits. Graph Theory: Complete graph or standard graph, connected graph, sub graph, tree of a graph, co-tree (complemented tree), planar graph etc. Incidence matrix, Fundamental loop matrix or tie set matrix, cut set matrix and its properties.

UNIT-2

Introduction to Transient Analysis: Classification of transients, DC transients: source free circuits (source free RL, RC, RLC circuits), with sources, initial and final conditions, Laplace transform approach (LTA) for solving transient problems. AC transients: steady state response and transient free condition for RL, RC, and RLC circuits.

AC circuit analysis: Sinusoidal steady state analysis by using phasors, phasor diagrams, concept of resonance or frequency domain analysis of RLC circuits. Average and RMS values of periodic signals, power calculations, locus or circle diagrams. Filters (LPF, HPF, BPF, BSF, APF) or frequency domain analysis of RL, RC, RLC circuits, state equations for networks, transmission criteria.

UNIT-3

Two-Port networks: Symmetric and reciprocal networks. Z, Y, h, g, ABCD, A'B'C'D' parameters and it's equivalent circuit representations. Cascade connection of 2-two port networks, Two port network representation for ideal transformer. Inter relationships between parameters of two port network, proofs for symmetry and reciprocity conditions. Inter connection of two port networks (series and parallel two port networks). T and π representations, lattice networks, image parameters, ladder networks

Network Synthesis: Network functions, pole and zero's, one port network, driving point impedance and driving point admittance functions. Realizations or synthesis: Foster Form-I, Foster Form-II, Cauer Form-I, Cauer Form-II, properties of driving point immittance function, Properties of RC DP, RL DP functions & necessary conditions for PR (Positive Real) function, properties of Hurwitz polynomial function.

UNIT-4

Coupled circuits: Analysis of coupled circuits, self-inductance, mutual inductance, coefficient of coupling, series connection of coupled coils, modelling of coupled circuits, dot convention in coupled coils. Electrical equivalent of magnetically coupled circuits, tuned coupled circuits (single tuned and double tuned coils), example problems.

Transformers: Working Principle, construction, classification: core and shell types, theory on no load, e.m.f. equation, turns ratio, voltage ratio and current ratio, losses and efficiency, equivalent resistance, reactance and impedance, voltage regulation, constants of transformer, open circuit and short circuit tests, predetermination of efficiency and regulation, all-day efficiency, auto-transformer: saving of copper, practical applications.

UNIT-5:

DC Generator: Basic principle, construction, rectifying action of commutator, armature windings: LAP and WAVE, classification of generators: shunt, series and compound, E.M.F. equation, generator on load, operating characteristics, critical resistance, concepts of armature reaction and commutation, practical applications. **DC Motor:** Principle of operation, back e.m.f. speed and torque equations, mechanical power developed, classification of motors: series, shunt and compound, operating characteristics, speed control, practical applications, motor starter: its necessity, 3-point starter, losses and efficiency.

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction and working of synchronous generators.

Course Outcomes

3. apply the knowledge of basic circuital law and simplify the network using reduction techniques.
4. Analyse the circuit using Kirchhoff's law and Network simplification theorems
5. Infer and evaluate transient response, Steady state response, network functions
6. Obtain the maximum power transfer to the load, and Analyse the series resonant and parallel resonant circuit.
7. evaluate two-port network parameters, design attenuators and equalizers
8. Synthesize one port network using Foster and Cauer Forms.
9. Analyse the transformers and coupled circuits.
10. Analyse the DC and AC generators & motors with applications.

Text Books:

4. Van, Valkenburg.; "Network analysis" ; Prentice hall of India, 2000.
5. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education.
6. "A Textbook of Electrical Technology" by B L Theraja and A K Theraja.
7. "Basic Electrical and Electronics Engineering" by S K Bhattacharya.

Reference Books:

7. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill NewDelhi, 1994.
8. Kuo F. F., "Network Analysis and Synthesis", 2nd Ed., Wiley India., 2008.
9. "Principles of Electrical Engineering and Electronics" by Mehta V K and Mehta Rohit.
10. Electrical Technology by Yoganarasimhan.

MA1201 **MATHEMATICS-II**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-1-0-4**

Course Objectives:

6. Methods of solving the differential equations of first and higher order.
7. To study the methods of solving improper integrals and the concepts of multiple integrals
8. The basic properties of vector valued functions and their applications to line, surface and 2volume integrals
9. To study numerical methods to analyze an experimental data.

Course Outcomes:

At the end of the course student will be able to

6. Solve first order linear differential equations and special non linear first order equations like Bernouli , Riccati &Clairaut's equations
7. Compute double integrals over rectangles and type I and II" regions in the plane
   - iii. Explain the concept of a vector field and make sketches of simple vector fields in the plane.
   - iii. Explain concept of a conservative vector field, state and apply theorems that give necessary and sufficient conditions for when a vector field is conservative, and describe applications to physics.
   - ii. Recognize the statements of Stokes' Theorem and the Divergence Theorem and understand how they are generalizations of the Fundamental Theorem of Calculus.
   - iii. Able to solve the problems in diverse fields in engineering science using numerical methods.

UNIT-I

Ordinary Differential Equations of first order: Exact first order differential equation, finding integrating factors, linear differential equations, Bernoulli's , Riccati , Clairaut's differential equations, finding orthogonal trajectory of family of curves, Newton's Law of Cooling, Law of Natural growth or decay.

UNIT-II

Ordinary Differential Equations of higher order:

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type $e^{ax}, sin(ax), cos(ax)$, polynomials in$x, e^{ax}V(x), xV(x)$; method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

UNIT-III

Integral Calculus:

Evaluation of the double integrals (Cartesian and Polar), change of order of integration (only Cartesian form), Evaluation of Triple integrals. Change of variables (Cartesian to polar) in case of double integrals (Cartesian to spherical and cylindrical) in case of Triple Integrals-Jacobians of transformations. Differentiation of integrals with variable limits - Leibnitz rule.

Applications: Finding Areas (using double integrals) and volumes (using double and Triple Integrals), Centre of mass, Centre of gravity for constant and variable densities by double and triple integrals (applications involving cubes, Sphere and rectangular parallelepiped)

UNIT-IV

Vector Differentiation: Vector point functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal line. Vector Identities. Scalar potential functions. Solenoidal and Irrotational vectors.

UNIT-V

Vector Integration: Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

Numerical Methods: Introduction and motivation about numerical methods, True value, approximate value, error, error percentage, algebraic equations, transcendental equations, Newton-Raphson method, Bisection method.

Text Books:

1.Advanced Engineering Mathematics (3rd Edition) by R. K. Jain and S. R. K. Iyengar, Narosa Publishing House, New Delhi

References Books

1. Advanced Engineering Mathematics (8th Edition) by Erwin Kreyszig, Wiley-India.

2. Dr. M.D. Raisinghania,Ordinary andPartialdifferentialequations,S.CHAND,17^{th}Edition2014.

PH1001 **PHYSICS**

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 1 - 0 - 4**

Total Number of Modules: 41 (One Module ~ 1 to 1.5 hours of Lecture hours)

UNIT I: Vectors and Mathematical Physics (5)
Gradient, Divergence, Curl and its applications .Line, surface and volume integrals, Stokes and Gauss theorem, Curvilinear Coordinates: Polar, Cylindrical and spherical polar co-ordinates, Problems.

UNIT II: Quantum Mechanics (6)
Introduction to Quantum Mechanics, De-Brogile waves and uncertainity principle, Time dependant Schrodinger wave equation, Significance of Wave Function, Time independent Schrodinger wave equation and solution of generalized potential, Particle in a box, Quantized energies, Problems.

UNIT III:Electron Structure of solids (6)
Introduction to Crystallography, Bravais Lattices, Basis, Unit Cell, Miller Indices, Electron Theory, Kronig Penny model (E vs K), Band theory of solids.

UNIT -IV :Conductive Materials and Dielectrics (10 + 4)
Electrical Conductivity
Free electron Theory of metals, Joule's Law, Relaxation Time, Collision time, Mean free path, Factors effecting electrical conductivity, Applications of conducting materials
Thermal Conductivity
Thermal conductivity of metals, Wiedemann-Franz Law, Thermoelectric phenomenon
Superconductors
Superconductivity, Properties of Superconductors, Types of Super conductors, Applications of Superconductors.
Dielectrics
Introduction to Dielectrics, Homogentity, Isotropy, Linearity, Types of Polarisation, Internal fields, Classification of dielectric materials based on dielectric behaviour and special feautures.

UNIT V:Semiconductor Materials (10)
Electrical conductivity of metals, semiconductors and insulators, Electrons and holes in an Intrinsic semiconductor (Pure), Extrinsic materials, Mechanism of current flow in a semiconductor, Charge densities, Electrical properties of semiconductors, Hall Effect,

Thermistors, Photoconductors, Generation and recombination of carriers, Recombination and Diffusion, Total current (Diffusion and Drift), Electrical properties of semiconductor.

Reference books:

1. Arfken, Mathematical Physics

2. David Griffiths, Quantum Mechanics

3. Wahab, Solid State Physics

4. S M Sze, Semiconductor Devices: Physics and Technology, Wiley (2008)

5. P.K.Palaniswamy, Applied Physics

CE1001 **ENGINEERING GRAPHICS**

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **1-0-4-3**

Course Objectives:

ii. To introduce the students to the "Universal Language of Engineers" for effective communication through drawing.
iii. To understand the basic concepts of drawing through modern techniques.
iv. To impart knowledge about standard principles of projection of objects.
v. To provide the visual aspects of Engineering drawing using Auto-CAD.

UNIT-I:(15 Hours)

Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, types of lines and Dimensioning.
Over view of Auto-CAD: Theory of CAD software (The Menu System, Tool Bars, drawing area, Dialogue boxes, Shortcut Menu, the command lines, Select and erase objects, Introduction to layers etc.), Drawing simple figures- lines, planes, solids.

UNIT-II: (10 Hours)

Geometrical constructions: Construction of regular polygons.
Conic sections: Construction of Ellipse, Parabola, Hyperbola (General method only), Cycloid, Epicycloid, Hypocycloid and Involutes.
Scales: Construction of Plain, Diagonal and Vernier scales.

UNIT-III: (20 Hours)

Orthographic projections: Principles of Orthographic Projections
Projections of Points: Projections of Points placed in different quadrants
Projection of lines: lines parallel and inclined to both the planes (Determination of true lengths and true inclinations and traces)

Projection of planes: Planes inclined to both the reference planes

UNIT-IV: (15 Hours)

Projection of Solids: Projection of solids whose axis is parallel to one of the reference planes and inclined to the other plane, axis inclined to both the planes
Projection of sectioned solids: Sectioning of simple solids like prism, pyramid, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

UNIT-V: (12 Hours)

Development of surfaces: Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone
Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views of planes and simple solids
Perspective projections: Basic concepts of perspective views.

Course Outcomes:

At the end of the course, the student will be able to

5. Use Engineering principles and techniques to understand and interpret engineering drawings.
6. Understand the concepts of Auto-CAD.
7. Draw orthographic projections of lines, planes and solids using Auto-CAD.
8. Use the techniques, skills and modern engineering tools necessary for engineering practices.

Text/Reference Books:

ii. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
iii. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
iv. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
v. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age publications
vi. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication

vii. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

viii. (Corresponding set of) CAD Software Theory and User Manuals

HS1001 **ENGLISH**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **2-0-0-2**

INTRODUCTION:

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic, communicative and critical thinking competencies of Engineering students. In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts leading to reading comprehension and different passages may be given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material etc. *The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures.*

Course Objectives: The course will help to

6. Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
7. Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
8. Develop study skills and communication skills in formal and informal situations.

Unit –I: ‘The Raman Effect’ from the prescribed textbook ‘English for Engineers’ published byCambridge University Press.

Vocabulary Building: The Concept of Word Formation --The Use of Prefixes and Suffixes.**Grammar:** Identifying Common Errors in Writing with Reference to Articles andPrepositions.**Reading:** Reading and Its Importance- Techniques for Effective Reading.**Basic Writing Skills:** Sentence Structures -Use of Phrases and Clauses in Sentences Importance of Proper Punctuation- Techniques for writing precisely – **Paragraph writing** –Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles ofParagraphs in Documents.

Unit –II: 'Ancient Architecture in India' from the prescribed textbook 'English for Engineers'published by Cambridge University Press.

Vocabulary: Synonyms and Antonyms.**Grammar:** Identifying Common Errors in Writing with Reference to Noun-pronounAgreement and Subject-verb Agreement.**Reading:** Improving Comprehension Skills – Techniques for Good Comprehension**Writing:** Format of a Formal Letter-**Writing Formal Letters** E.g.., Letter of Complaint,Letter of Requisition, Job Application with Resume.

Unit –III: 'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English toform Derivatives-Words from Foreign Languages and their Use in English.**Grammar:** Identifying Common Errors in Writing with Reference to Misplaced Modifiersand Tenses.**Reading:** Sub-skills of Reading- Skimming and Scanning**Writing**: Nature and Style of Sensible Writing-**Defining- Describing** Objects, Places andEvents – **Classifying**- Providing Examples or Evidence

Unit –IV: 'What Should You Be Eating' from the prescribed textbook 'English for Engineers'published by Cambridge University Press.

Vocabulary: Standard Abbreviations in English**Grammar:** Redundancies and Clichés in Oral and Written Communication.**Reading**: Comprehension**-** Intensive Reading and Extensive Reading**Writing: Writing Practices-**-Writing Introduction and Conclusion - Essay Writing-PrécisWriting.

Unit –V: 'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'Englishfor Engineers' published by Cambridge University Press.

Vocabulary: Technical Vocabulary and their usage**Grammar:** Common Errors in English**Reading:** Reading Comprehension-Exercises for Practice**Writing: Technical Reports**-Introduction – Characteristics of a Report – Categories ofReports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Course Outcomes: Students should be able to
Use English Language effectively in spoken and written forms.

- Comprehend the given texts and respond appropriately.
- Communicate confidently in various contexts and different cultures.
- Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Prescribed Textbook:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

References:

- Swan, M. (2016). Practical English Usage. Oxford University Press.
- Kumar, S and Lata, P.(2018). Communication Skills. Oxford University Press.
- Wood, F.T. (2007).Remedial English Grammar. Macmillan.
- Zinsser, William. (2001). On Writing Well. Harper Resource Book.
- Hamp-Lyons, L. (2006).Study Writing. Cambridge University Press.
- Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

BM0005 CONSTITUTION OF INDIA

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**2-0-0-0**

8.1 Constitution of India – Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in the world".

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India

13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

HS1201 **Communication Skills II**

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **2-0-0-0**

Objectives:

4. To develop the learners ability to read fluently and critically.
5. To make awareness of the common punctuation marks and the importance of it in writing
6. To build academic vocabulary of the learners
7. To offer the learners opportunity to practice creative writing
8. To make the learners apply the skills and strategies of a successful listener

Unit I – Reading

Reading Skills – Importance - Definition –Types -Techniques and strategies

Unit II – Punctuation and Capitalization

Punctuation - Use of Capital Letters

Unit III – Vocabulary

- Antonyms
- Synonyms
- Affixation

- Vocabulary in context
- Proverbs /Collocations
- One word substitutes
- Idioms and Phrasal verbs

Unit IV – Writing Skills
Creative writing – Story Writing – Precise - Letter writing

Unit V - Listening
Listening Skills – Academic Listening – Listening to Talks and Presentations – Note Taking

Course Outcomes:

The learners will be able to:

2. Make use of contextual clues to infer meanings of unfamiliar words from context and make inferences and predictions based on comprehension of a text
3. Punctuate simple sentences correctly
4. Produce appropriate vocabulary and correct word forms;
5. Write creatively and accurately. They will also have a critical awareness of their writing in terms of unity, content, coherence and linguistic accuracy (grammatical structure and choice of vocabulary).
6. Comprehend the talks and presentations, take organized notes on lectures and listening passages

References:

- Meenakshi Raman and Sangeeta Sharma ***"Communication skills"*** Oxford University press, 2013
- Wren and Martin, NDV Prasad Rao. *"**High School English Grammar and Composition**"* S. Chand& Compay Ltd, 2012
- Michael Swan, ***"Practical English Usage"*** 3rd edition: guide to problems in English, Oxford University press, 2011
- Edgar Thorpe and Showick Thorpe, ***"Objective English"*** 3rd Edition, Pearson, 2010

EE1602 BASIC ELECTRICAL ENGINEERING LAB

External:60 Marks **L-T-P-C**
Internal:40 Marks **0-0-3-1.5**

COURSE OBJECTIVES: To provide practical exposure to

- Prepare the students to have a basic knowledge in the analysis of Electric Networks.
- Solve the given circuit with various theorems and methods.
- Relate various two port parameters and transform them.
- Common electrical components, their ratings and applications.
- Common electrical measuring instruments and their usage.
- Transformers and electrical machines.

LIST OF EXPERIMENTS

NT LAB EXPERIMENTS:

1. Verify KCL and KVL for DC circuits.

2. Verify mesh and nodal analysis for DC circuits.

3. Determine and verify superposition theorem.

4. Determine and verify Thevenin's and Norton's theorem.

5. Determine and verify Maximum power transfer theorem.

6. Calculate and verify 'Z' ,'Y', h' and 'g' parameters of two-port network.

ET LAB EXPERIMENTS:

1.Introduction to Lab:

(a).Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.

(b).Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.

(c).Demonstration of Components of LT switchgear.

2.Transformers: Observation of the no-load current waveform on an oscilloscope (non sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).Loading of a transformer: measurement of primary and secondary voltages and currents, and power.

3.Three-phase transformers: Star and Delta connections. Voltage and Current relationships(line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.

4. Series Resonance in R-L-C circuits.

5. Study and plot the transient Response of RL, RC circuit.

COURSE OUTCOMES:

At the end of the course student will have ability to

- Articulate in working of various components of a circuit.
- Familiar with ac and dc circuits solving.
- Ready with the most important concepts like mesh and nodal analysis.
- Express given Electrical Circuit in terms of A,B,C,D and Z,Y Parameter model and solve the circuits.
- Understand principles of measuring instruments of voltage, current and power
- Analyze the characteristics and evaluate performance of DC Motor, induction motor and transformers

PH1601 PHYSICS LAB

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-3-1.5**

List of Experiments:

3. Band Gap of a semiconductor
4. Hall effect
5. Frank Hertz experiment
6. Photoelectric effect
7. Seebeck and Peltier effect
8. Dielectric constant
9. Solar Cell
10. Compton effect

HS1601 **ENGLISH LANGUAGE LAB**

Orals (Written): 50Marks **L-T-P-C**
Written (Externals): 50Marks **0-0-2-1**

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:

6. To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
7. To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm.
8. To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
9. To improve the fluency of students in spoken English and neutralize their mother tongue influence

10. To train students to use language appropriately for public speaking and interviews

Syllabus of English Language Lab (Computer Assisted Language Learning (CALL) Lab):

Listening Skills:

Objectives:

3. To enable students, develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation
4. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions.

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills:

Objectives:

6. To involve students in speaking activities in various contexts
7. To enable students express themselves fluently and appropriately in social and professional contexts

- Oral practice: Just A Minute (JAM) Sessions
- Describing objects/situations/people
- Role play – Individual/Group activities

The following course content is prescribed for the English Language and based on AICTE Model Curriculum 2018 for B.Tech First year. As the syllabus is very limited, it is required to prepare teaching/learning materials by the teachers collectively in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning and timesaving in the Lab.

Unit – I:

Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening - Communication at Work Place- Spoken vs. Written language.

Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants -Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

UNIT – II

Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context- Features of Good Conversation – Non-verbal Communication.

Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context-Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

UNIT - III

Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI)- How to make Formal Presentations.
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation- Formal Presentations.

UNIT – IV
Understand: Listening for General Details-Public Speaking – Exposure to Structured Talks.
Practice: Listening Comprehension Tests- Making a Short Speech – Extempore
UNIT – V
Understand: Listening for Specific Details- Interview Skills.
Practice: Listening Comprehension Tests- Mock Interviews.

Learning Outcomes: Students will be able to attain

7. Better understanding of nuances of English language through audio- visual experience and group activities
5. Neutralization of accent for intelligibility
6. Speaking skills with clarity and confidence which in turn enhances their employability skills

Suggested References:

3. Clarity English Success - Software
4. Connected Speech- Software
5. Issues in English 2- Software
6. http://www.clarityenglish.com/program/practicalwriting/
7. http://www.clarityenglish.com/program/roadtoielts/

8. http://www.clarityenglish.com/program/clearpronunciation1/
9. http://www.clarityenglish.com/program/resultsmanager/

III SEMESTER

EC2101 DIGITAL ELECTRONIC CIRCUITS
(for ECE and CSE)

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**3-0-0-3**

UNIT-I: Introduction

Digital & analog signals, Number System, BCD & its arithmetic, Binary, Decimal, Octal, Hexadecimal, Negative numbers& its arithmetic, Number base conversions,

Unit II: Logic Realization & Simplification:

Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes,Code Conversion. Logic Gates and its realization.

Unit III:Combinational Logic Design:

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU, parity generator, checker

Unit IV: Sequential Logic Design:

Building blocks like S-R, JK and Master-Slave JK FF, T-FF, D-FF and Flip-Flop conversions. Shift Registers (SISO, SIPO, PISO, PIPO), universal shift register.Synchronous and Asynchronous counters and it's realization.Programmable logic Families: PAL, PLA.PROM.

Unit V:Finite State Machines:

Design ofsynchronous FSM, Mealy model, Moore model, state diagrams and state reduction method, overlapping & Non-overlapping models.Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. A basic understanding of Boolean algebra and theorems for optimization
2. Design and developing of combinational logic circuits, storage cells for sequential circuit realization
3. Dissemination of sequential circuits for high end applications and FSM realizations
4. A glimpse on various logic families and their impacts in circuit realizations

TEXTBOOKS:

1. Switching & Finite Automata theory – Zvi Kohavi, TMH,2^{nd} Edition.

2. Digital Design – Morris Mano, PHI, 3rd Edition, 2006.

3. Switching Theory and Logic Design-A.Anand kumar, 2008.

REFERENCES:

1. An Engineering Approach to Digital Design – Fletcher, PHI.

2. Fundamentals of Logic Design – Charles H. Roth, 5th Edition, 2004, Thomson Publications.

3. Digital Logic Applications and Design – John M. Yarbrough, 2006.

EC2102 ELECTRONIC DEVICES AND CIRCUITS

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**3-1-0-4**

Course Objectives:

3. To introduce the fundamental concepts of semiconductor materials and its characteristics.
4. Identify the whether the semiconductor material is p-type or n-type by using Hall Effect.
5. To understand the basic structure of p-n junction diode and Tunnel diode it's working principles.
6. To understand the applications of Bipolar Junction Transistor and Unipolar Junction Transistor and its different modes of operation.
7. To understand the basics of optical electronics like Photo detectors, Photoluminescence, Electroluminescence, Led and laser.
8. To understand the basic IC fabrications & Logic families.

UNIT-1

Semiconductor Physics: Review of semiconductor physics. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equation, Hall effect.

Diodes: Qualitative Theory of P-N Junction, P-N Junction as a Diode, Diode Equation, Volt- Ampere Characteristics, Temperature dependence of V-I characteristic, Ideal versus Practical – Resistance levels(Static and Dynamic), Transition and Diffusion Capacitances, Diode Equivalent Circuits, Load Line Analysis, Breakdown Mechanisms in Semiconductor Diodes, Zener Diode Characteristics and its applications.

UNIT-2

Rectifiers and Filters: The P-N junction as a Rectifier, Half wave Rectifier, Full wave Rectifier, Bridge Rectifier, Harmonic components in a Rectifier Circuit, Inductor Filters, Capacitor Filters, L- Section Filters, π- Section Filters, Comparison of Filters.

Opto-Electronics: Optical sources: LED, LASER. Direct & Indirect band gap semiconductors. Optical detectors: Photo diode, Pin diode, Avalanche Photo Diode (APD), Solar cell, LCD.

UNIT-3

Bipolar Junction Transistor: The Junction Transistor, Transistor Current Components, Transistor as an Amplifier, Transistor Construction, non-ideal effects of BJT: Base width modulation, Emitter band gap narrowing, non-uniform base doping, breakdown voltage. BJT Operation, Common Base, Common Emitter and Common Collector Configurations, Limits of Operation, BJT Specifications.

Transistor Biasing and Stabilization: Operating Point, The DC and AC Load lines, Need for Biasing, Fixed Bias, Collector Feedback Bias, Emitter Feedback Bias, Collector - Emitter Feedback Bias, Voltage

Divider Bias, Bias Stability, Stabilization Factors, Stabilization against variations in V_{BE} and β, Bias Compensation using Diodes and Transistors, Thermal Runaway, Thermal Stability.

UNIT-4

Field Effect Transistor: The Junction Field Effect Transistor (Construction, principle of operation, symbol) – Pinch-off Voltage - Volt-Ampere characteristics, The JFET Small Signal Model, MOSFET (Construction, principle of operation, symbol), MOSFET Characteristics in Enhancement and Depletion modes.

FET Amplifiers: FET Common Source Amplifier, Common Drain Amplifier, Generalized FET Amplifier, Biasing FET, FET as Voltage Variable Resistor, Comparison of BJT and FET.

UNIT-5

Special Purpose Electronic Devices: Principle of Operation and Characteristics of Tunnel Diode (with the help of Energy Band Diagram), Varactor Diode, Schottky Barrier diode, Point contact diode.

Power Switching Devices: Introduction to: SCR, UJT, DIAC, TRIAC and its applications.

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Students will be good at fundamental concepts of semiconductor materials and its characteristics.
- Students will be ability to identify the whether the semiconductor material is p-type or n-type by using Hall Effect.
- Students will be good at the basic structure of p-n junction diode and Tunnel diode it's working principles.
- Students will know the applications of Bipolar Junction Transistor and Unipolar Junction Transistor and its different modes of operation.
- Students will be good at the basics of optical electronics like Photo detectors, Photoluminescence, Electroluminescence, Led and laser.
- Students will be having knowledge on basic IC fabrications & logic families.

Text Books:

2. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson,2014.
3. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education.
4. Jacob Millman, Christos C Halkias and Satyabrata JIT, “ Electronics Devices and Circuits”, 3rd Edition.

Reference Books:

7. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley&Sons, 2006.
8. C.T. Sah, “Fundamentals of solid state electronics,” World Scientific Publishing Co. Inc, 1991.
9. Y. Tsividis and M. Colin, “Operation and Modeling of the MOS Transistor,” Oxford Univ.Press, 2011.

EC2103 SIGNALS AND SYSTEMS
(only for ECE)

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-1-0-4**

UNIT I: Introduction to Signals and Systems

Signals and systems as seen in everyday life, and in various branches of engineering and science. Continuous and discrete time signals, Analog and Digital signals and some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; Signal properties: periodicity, absolute integrability, determinism and stochastic character, energy and power, odd and even, Operations on independent variables of the signal: Time shifting, reversal, scaling; System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability with examples.

Unit II: Behavior of continuous and discrete-time LSI systems

Impulse response and step response, convolution with examples, cascade interconnections. Characterization of causality and stability of LSI systems. System representation through differential equations and difference equations. Periodic inputs and semi periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response. notion of eigen functions of LSI systems, a basis of eigen functions.

Unit III: Fourier Transform

The idea of signal space and orthogonal bases, Fourier series representation of periodic signals with examples, Waveform Symmetries. Continuous Time Fourier Transform and it's properties including Parseval's Theorem and Duality, magnitude and phase response, The DiscreteTime Fourier Transform (DTFT). Ideal Filters, R-C first order LPF, HPF, BPF circuits and its frequency domain analysis using transfer function.

Unit IV: Laplace Transform

Review of the Laplace Transform for continuous time signals and systems, Region of Convergence, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. Butterwoth LPF, HPF and BPF and its realization.

Unit V: Sampling and Reconstruction

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems.

Course outcomes:

At the end of this course students will demonstrate the ability to

i. Analyze different types of signals
ii. Represent continuous and discrete systems in time and frequency domain using different transforms
iii. Investigate whether the system is stable
iv. Sampling and reconstruction of a signal

Text/Reference books:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

EC2901 ELECTRONICS MINI PROJECT-I

L-T-P-C
0-0-2-1

Topics:

Analog Filter Design:

a. Butterwoth, Chebyschev, Elliptic filter design for LPF, HPF, BPF, BSF (Need to verify with MultiSim software and realize the same using passive components)
b. Concepts related to Instrumentation and Measurements

MA2101 MATHEMATICS-III
(Linear Algebra and Complex Analysis)

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-1-0-4**

Course objectives: To make Students learn concepts and methods described in the syllabus, so that they will be able to solve their engineering problem using linear algebra, functions of complex variable wherever applicable. They will come to know a number of applications of linear algebra, and especially they will learn about SVD and applications to image processing.

Also make them learn fair amount of calculus of functions of complex variables, like complex differentiation and integration and residue calculus which is will become a handy tool for definite integration for them.

To Solve the Differential & integral equations using Laplace Transform.
To know the Applications of Laplace Transforms.

Learning Outcomes: At the end of the course the student will be able to

3. Use shifting theorems to compute the Laplace transform and inverse Laplace transform
4. Solve Differential equations and Partial differential equations using Laplace Transforms.
5. Write the LU, QR, SVD decompositions for given matrices.
6. Finding the Orthogonal basis for a given Inner Product space.
7. Evaluate improper real integrals using Residue theorem.

Unit-I:

Vector space and Subspaces,Linear Independence and Basis and Dimension, The Four Fundamental Subspaces of matrix. Fundamental theorem of Linear algebra. LU and LDU factorization of Matrices. Solving the system of equations using LU decomposition. Inner product space onR^n, Cauchy Schwartz inequality, Orthogonality.Projections and Least squares solution.

Unit-II:

Orthogonal basis and Orthonormal basis, Gram-Schmidt Orthogonalization, QR Factorization. Review of Eigen values and Eigen vectors, Diagonalization and Diagonalizing symmetric matrix, application of diagonalization (power of matrices), and Spectral theorem. Positive definite Matrices, and properties. Singular value decomposition, Applications in Signal processing: Image compression

UNIT-III
Complex Variable – Differentiation

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding

Harmonic conjugate; Elementary analytic functions (exponential, trigonometric, logarithm) andtheir properties; Conformal mappings, Mobius transformations and their properties

Unit-IV

Complex Variable-Integration

Contour integrals, Cauchy-Goursat theorem (without proof), and Cauchy Integral formula (withoutProof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series,Zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem(Without proof), Evaluation of definite integral involving sine and cosine functions .Evaluation of certainimproper integrals using the Bromwich contour

Unit-V:

Laplace Transform: Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function. Differentiation and integration of transforms, convolution theorem,

Inverse Laplace Transform, periodic functions. Evaluation of integrals by Laplace Transform. Solution of initial and boundary value problems and solving Differential Equations & Integral Equations.

Text Books:

- Introduction to Linear Algebra ,Gilbert Strang fourth edition
- Advanced Engineering Mathematics (3rd Edition) by R. K. Jain and S. R. K. Iyengar, Narosa Publishing House, New Delhi
- B.S. Grewal and J.S. Grewal, "Higher Engineering Mathematics",(40th Edition), Khanna Publishers,2007

References Books:

- Advanced Engineering Mathematics (8th Edition) by Erwin Kreyszig, Wiley-India.
- Dr. M.D. Raisinghania,Ordinary and Partialdifferentialequations,S.CHAND,17thEdition2014.
- R.V.Churchill, " Complex Variables & its applications",Mc Graw-Hill Company,INC.

HS2101 **ESSENCE OF INDIAN KNOWLEDGE TRADITION**

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **2-0-0-0**

Unit –I

Basic Structure Of Indian Knowledge System:

Veda (Ayurveda, Dhanurveda, Gandharva Veda, Sthapatya Aati(Shilpa Veda), Artha Veda, Veedanga (Shiksha, Kalpa, Chhanda, Niruktha, Vyakarana, Jyothishya) Darma Shastra, Mimasha, Purana, Tarkashastra

Unit – II

Modern Science And Indian Knowledge System

Yoga Holistic Health Care

Unit – III

Indian Philosophical Tradition:

A) Orthodox (Hindu) School: Samkya, Yoga, Nyaya, Vaisheshika, Purva Mimamsa, Vedhanta,

B) Hetorodox (Non-Hindu) Schools: Carvaka, Jain, Buddha

Unit-IV

Indian Linguistic Tradition:

Phonology, Morphology, Syntax And Semantics

Unit –V

Indian Artistic Tradition:

Chitra Kala, Mantra Kala, Vaastu Kala, Sangeetha Kala, Nruthyu Evam Sahityam

BS2101 **ENVIRONMENTAL SCIENCE**

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-0**

UNIT 1:MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, scope and importance, need for public awareness.

UNIT 2: NATURAL RESOURCES:

Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- .Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

UNIT 3: ECOSYSTEMS & BIODIVERSITY

Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystems:-

- Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).
- Biodiversity- Definition : genetic, species and ecosystem diversity. Biogeographical classification of India Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values.
- Biodiversity at global, National and local levels. Inida as a mega-diversity nation Hot-sports of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT 4: ENVIRONMENTAL POLLUTION

Definition, Cause, effects and control measures of :- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards

8. Solid waste Management: Causes, effect s and control measures of urban and industrial wastes.
9. Role of an individual in prevention of pollution
10. Disaster management: floods, earthquake, cyclone and landslides.
11. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
12. Environment Protection Act., Air (Prevention and Control of Pollution) Act. Water Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act .

UNIT 5 : SOCIAL ISSUES & THE ENVIRONMENT

Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Field work : Visit to a local area to document t environmental assets river/ forest/grassland/hill/mountain Visit to a local polluted site-Urban/Rural/Industrial/Agricultural . Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc.

REFERENCES :

a). Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
b). Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad- 380 013, India, Email:mapin@icenet.net (R)

c). Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
d) Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
e). Cunningham, W.P. Cooper, T.H. Gorhan i, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
f). De A.K., Environmental Chemistry, Wiley Eastern Ltd.
g). Down to Earth, Centre for Science and Environment (R)
h). Gleick, H.P. 1993. Water in Crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
i). Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R) j) Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.
k). Jadhav, H & Bhosale, V.M. 1995. Environm ental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
l). Mckinney, M.L. & School, R.M. 1996. Environmental Science Systems & Solutions, Web enhanced edition. 639p.
m). Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
n). Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
o). Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
p). Rao M N. & Datta, A.K. 1987. Waste Wate r treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
q). Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
r). Survey of the Environment, The Hindu (M)
s). Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science.
t). Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R).
u). Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB).
v). Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p
(M) Magazine (R) Reference (TB) Textbook Members of the Expert Committee on Environmental Studies

1. Prof. Erach Bharucha, Director
Bharati Vidyapeeth, Institute of Environment Education & Research, Pune

2. Prof. C. Manoharachary
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Prayavaran Bhawan, CGO Complex
Lodhi Road, New Delhi-110 003

UGC OFFICIALS

6. Dr. N. K. Jain
Joint Secretary UGC, New Delhi

EC2701 DIGITAL ELECTRONIC CIRCUITS LAB (for CSE and B16 regular ECE only)

Externals: 60Marks L-T-P-C Internals: 40Marks 0-0-2-1

Course Objectives:

- To learn differences between analog systems and digital systems.
- To learn basic techniques for the design of digital circuits.
- To understand fundamental concepts used in the design of digital systems.
- To understand the concepts of various combinational and sequential circuits.
- To learn various techniques for logic circuit reduction.

LIST OF EXPERIMENTS:

- I/O characteristics of a Universal, Basic, Arithmetic gates
- Design of a digital comparator
- Check the functionality of a 1bit full adder circuit and subtractor
- Develop 4bit RCA
- Realize the functionalities of encoders and decoders
- Design sr-latch and flip flop
- Design jk-latch and flip flop
- Functioning of shift register, master slave flip flop, ALU
- Design of asynchronous and synchronous counters
- Verify the functionality of a n*1multiplexer and 1*n demultiplexer
- Design of a 7-segment LED display

Course Outcomes:

- Design, Analysis, Implementation and testing of logic gates and functions.
- An ability to analyze, implement and testing of combinational circuits.
- Design, Analysis, Implementation and testing of flip-flops and registers.
- An ability to analyze, implement and testing of counters.
- Design, Analysis, Implementation of application level projects.

19EC2702 ELECTRONIC DEVICES AND CIRCUITS LAB

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Section 1: Basics of Electronic Circuits

Section 2: Electronic Device Characteristics

Course Objective:

6. To understand usage of basic electronic equipments like Oscilloscope, Function generator, Multimeter ..etc.
7. To understand the basic electronic components like passive components, active components, bread board, etc.
8. To design the basic circuits by using diodes, zener diode etc.
9. To understand the characteristics of the diodes, Transistors.

Lab 1: Basics of Electronic Circuits

- Familiarization of electrics components and usage of multimeter.
- Familiarization with Oscilloscope and function generator.
- Frequency response and square wave rectifying of RC, CR and RL networks.
- Half wave and full wave rectifiers, Rectification with capacitance filters, Zener diode and IC regulation.
- Study of CE, CB, CC amplifier on kit.

Lab 2: Device Characteristics

- Characteristics of Diodes
  - PN Junction Diode
  - Zener Diode
  - Light Emitting Diode
  - Tunnel Diode
  - Schottky Diode
  - Varactor Diode
- Characteristics of Transistor
  - Bipolar Junction Transistor (Common Base, Common Collector, Common Emitter)
  - Unipolar Junction Transistor (p-channel JFET, n-channel JFET)
  - MOSFET (p-channel enhancement mode MOSFET, n-channel enhancement mode MOSFET, p-channel depletion mode MOSFET, n-channel depletion mode MOSFET)
- Characteristics of Silicon Controlled Rectifier

Course Outcomes: After completion of this lab

6. Students get the ability for usage of basic electronic equipment like Oscilloscope, Function generator, Multimeter ..etc.
7. Students will be having knowledge on the basic electronic components like passive components, active components, bread board, etc.
8. Students can design the basic circuits by using diodes, zener diode etc.
9. Students having the knowledge on characteristics of the diodes, Transistors.

Text /Reference Books:

- Electronic Devices and Circuit Theory – Robert L.Boylestad, Louis Nashelsky, 9th edition, 2008 PE.
- Electronic Devices and Circuits- David A. Bell- 5th Edition, Oxford University Press.

- Jacob Millman, Christos C Halkias and Satyabrata JIT, " Electronics Devices and Circuits", 3rd Edition.
- G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.
- D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education.
- S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley&Sons, 2006.
- C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
- Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

IV SEMESTER

EC2201 ANALOG CIRCUITS (only for ECE)

Externals: 60Marks L-T-P-C Internals: 40Marks 3-0-0-3

Course Objectives:

- The concepts of small signal equivalent circuits of BJT, FET and it's frequency response.
- The concept of multistage amplifiers, differential amplifiers and current mirrors for high input impedance.
- The fundamental concepts of positive and negative feedback and their applications.
- The performance analysis of Operational amplifiers and it's applications.
- The concept of large signal amplifiers and radio frequency amplifiers.

UNIT-I

Diode Applications: Diode Circuits (diode equivalent circuit, clippers, clampers)

Small Signal Analysis: Amplifier models: Voltage amplifier, current amplifier, trans conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

UNIT-II:

High Frequency Analysis: High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier.

Power Amplifiers: Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues.

Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits.

UNIT-III:

Oscillators: Review of the basic concepts, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.

Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load. **Differential amplifier:** Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.

UNIT-IV:

OP-AMP: Introduction of op-amp and its internal circuit diagram. Ideal and practical op-amp with transfer characteristics.

OP-AMP applications: Review of inverting and non-inverting amplifiers, virtual ground concept. Linear op-amps (Adders, Subtractors, V-V, V-I, I-V, I-I amplifiers, Instrumentation amplifier); Non-linear op-amps (Rectifiers, Peak detector, Clipper, Clamper, Logarithmic amplifier) and multipliers; Open loop op-amps (Comparator, Detector); Positive Feedback op-amps (Schmitt trigger, Multivibrators)

Active filters Design: Low pass, high pass, band pass and band stop, design guidelines.

UNIT-V:

Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc.

Analog-to- digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.

Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

Course outcomes:

- An ability to design and analyze the BJT & FET amplifiers at low frequency, mid frequency and high frequency regions.
- An ability to design and perform the cascade amplifiers (i.e. multistage amplifiers) and its frequency response.
- An ability to analyze a given differential amplifier or design a differential amplifier to meet the given specifications with constant current bias circuit.
- An ability to design and analyze the positive feedback and negative feedback amplifiers for a given specifications.
- An ability to design and perform op-amp based circuits and it's applications for a given specifications.

- An ability to understand the large signal amplifiers (i.e. power amplifiers) and its efficiency calculations.
- An ability to understand the waveform generators, timers and analog to digital converters & digital to analog convertors, switched capacitor.

Text Books :

- Electronics Devices and Circuit Theory Boylestad, Robert & Louis, Nashelsky Pearson, 10th Edition
- Microelectronic Circuits-Theory and applications by Adel S. Sedra and Kenneth C.Smith, Fifth Edition , (Oxford International Student Edition)
- Electronic Devices and Circuits- Millman and Halkias, TMH
- Op-Amps and Linear Integrated Circuits Gayakwad , Ramakant A PHI, Learning,4 th Edition Electronic Devices and Circuits Dr. Sharma, Sanjay KATSON,2012

Reference books:

- Fundamentals of Electronic Devices and Circuits David, A Bell Oxford Press, 5thEdition, 2008
- Electronic Principles - with simulation CD Malvino, A.P. Tata McGraw- Hill , Education,7 thEdition
- Basic Electronics and Linear Circuits Bhargava, N.,Kulshreshtha D., S.Gupta Tata McGraw- Hill Education, 2011
- Electronics Devices and Circuits Mottershead, Allen PHI Learning,2011
- Electronic Devices and Circuits- David A Bell - PHI 4th edition

MOOCs:

- https://www.mooc-list.com/course/electronic-systems-and-digitalelectronics-uninettuno?static=true
- http://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-012-microelectronic-devices-and-circuits-spring-2009
- Introductory Analog Electronics Laboratory (Spring 2007) by MIT Open Courseware | Reviews and Ratings

EC2202
CONTROL SYSTEMS

Externals: 60Marks
L-T-P-C
Internals: 40Marks
3-0-0-3

Course Objectives:

6. To familiarize the students with the need for modelling of systems and to represent the system in various ways mathematically.
7. To teach them the various well-established techniques to analyze the stability of systems and related issues.
8. Ability to find time response of given control system model &plot Root

Locus and Bode plots for given control system model
9. Ability to design Lead, Lag, Lead-Lag systems in control system & Ability to design PID controllers for given control system model.
10. Ability to learn state space analysis and optimal control system.

UNIT-I: INTRODUCTION
Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of Feedback, Mathematical modeling of physical systems: Differential equation and Transfer functions, Examples of modeling different types (e.g. electrical, mechanical, chemical, biological, social etc.) of systems, Equivalence between the elements of different types of systems. Block diagram algebra –Signal flow graph - Reduction using Mason 's gain formula. Translational and rotational mechanical systems.
UNIT-II: TIME DOMAIN ANALYSIS
Standard test signals - Time response of first order systems –Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications. Steady state response - Steady state errors and error constants, Frequency domain response -- Transfer function and its interpretation in terms of frequency responses peak and peaking frequency, bandwidth and cut-off rate; Link between time and frequency domain response features. Advantages of closed loop operation: Sensitivity and complementary sensitivity, Disturbance and noise reduction.
UNIT-III: STABILITY ANALYSIS IN S-DOMAIN
The concept of stability – Routh 's stability criterion – qualitative stability and conditional stability – limitations of Routh 's stability. The root locus concept - construction of root loci- and relative stability using root-locus approach, effects of adding poles and zeros to G(s)H(s) on the root loci.

UNIT-IV: FREQUENCY DOMAIN ANALYSIS
Polar Plots-Nyquist Plots-Stability Analysis. Bode diagrams- Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain Margin-Stability Analysis from Bode Plots. P, PD, PI, PID Controllers and Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain.
UNIT-V: STATE VARIABEL ANALYSIS
State variable Analysis- Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability. Introduction to Optimal control & Nonlinear control, Optimal Control problem, Regulator problem, Output regulator, treking problem. Nonlinear system – Basic concept & analysis.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Characterize a system and find its study state behaviour
2. Investigate stability of a system using different tests
3. Design various controllers
4. Solve liner, non-liner and optimal control problems

Text Books:

6. Automatic Control Systems– by B. C. Kuo and Farid Golnaraghi – John wiley and son‘s, 8th edition, 2003.
7. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 5th edition, 2007.

Reference Books:

- Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 5th edition, 2010.
- Control Systems Engineering - by NISE 5th Edition – John wiley.

EC2203

ELECTROMAGNETIC WAVES

Externals: 60Marks

L-T-P-

C Internals: 40Marks

3-0-0-3.

Unit I: INTRODUCTION TO TRANSMISSION LINES:

Concept of distributed elements, equations of voltage and current, standing waves and impedance transformation, lossless and low loss transmission lines, power transfer on a transmission line, short circuit and open circuit lines, parameters of transmission line.

SMITH CHART: applications, applications of transmission line, impedance matching using transmission lines.

Unit II: BASIC LAWS OF ELECTROMAGNETICS:

Gauss's law, Ampere's circuital law, Faraday's law of electromagnetic induction.

Maxwell's equations: Surface charge and Surface current, Displacement current and continuity equation, Boundary conditions at media interface.

Unit III: UNIFORM PLANE WAVES I:

Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity and Poynting vector

Uniform plane waves ii: Plane wave in arbitrary direction, Reflection and refraction of waves at dielectric and conducting interface, Total internal reflection, Brewster angle.

Unit IV: WAVE GUIDES:

Parallel plane wave guide, TE mode, TM mode, TEM mode,

Rectangular wave guides: Group velocity and dispersion, Analysis of rectangular wave guides.

Unit V: ANTENNAS:

Introduction,Radiation parameters of antenna, potential functions and their solutions.

FIELDS: Near and far fields, Radiation resistance and radiation pattern of Hertz dipole, total power radiated by a dipole.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Understand characteristics and wave propagation on high frequency transmission lines
2. Carryout impedance transformation on TL
3. Use sections of transmission line sections for realizing circuit elements
4. Characterize uniform plane wave
5. Calculate reflection and transmission of waves at media interface
6. Analyze wave propagation on metallic waveguides in modal form
7. Understand principle of radiation and radiation characteristics of an antenna

Text Books:

6. R.K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.
7. D. K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley, 1989.
8. M.N.O. Sadiku, "Elements of Electromagnetics", Oxford University press, 2007.
9. C.A. Balanis, "Advanced Engineering Electromagnetics" , John Wiley and sons, 2012.
10. C. A. Balanis, "Antenna Theory: Analysis and Design" , John Wiley and sons,2005

EC2204 PROBABILITY THEORY AND STOCHASTIC PROCESSES

Externals: 60Marks

L-T-P-

C Internals: 40Marks

3-1-0-4

Unit I

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Independent events, Combinatorial probability and sampling models.

Unit II

Discrete random variables, probability mass function, probability distribution function, example random variables and distributions;Uniform, Geometric and it's memoryless property, Bernouli, Binomial, Poisson distributions.

Continuous random variables, probability density function, probability distribution function, example distributions; Uniform, Exponential and it's memoryless property, Gaussian distribution, Standard Normal distribution, Q(.) function, Heavy tailed Pareto distribution.

Unit III

Joint distributions, Jointly Gaussian random variables, Marginal distributions, Independent random vatiable, functions of one and two random variables, Sum of random variables, minimum, maximum of random variables, log normal distribution, Rayleigh distribution, Chi-square distribution, Square of Rayleigh random variable, moments of random variables;

Conditional distribution, densities and moments; Mean, Variance, Covariance, Correlation, Correlation coefficient, Covariance Matrix. Uncorrelated random variables. Conditional expectation. Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds; Cauchy Schwarz inequality. Use of MATLAB for generating: random Gaussian samples, Rayleigh distributed samples generation using two IID Gaussian samples. Transformation of random variables: Generating Exponential distributed samples using Uniform distributed samples.

Unit IV

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

Unit V

Random process, Stationary processes: Strict sense stationary, Wide sense stationary processes. Gaussian Random process, Mean and covariance functions. Ergodicity. Transmission of random process through LTI. Power spectral density.

Course Outcomes:

At the end of this course students will demonstrate the ability to

i. Understand representation of random signals
ii. Investigate characteristics of random processes
iii. Make use of theorems related to random signals
iv. To understand propagation of random signals in LTI systems.

Text/Reference Books:

ii. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education

iii. A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.

iv. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International

v. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,

vi. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers

vii. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

CS2205 OBJECT ORIENTED PROGRAMMING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Objectives:

6. The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, an appropriate framework for automated unit and integration tests.
7. To understand Object oriented programming concepts, and apply them in Problem solving.
8. To learn the basics of Java Console and GUI based programming

Detailed Contents:

UNIT-1:

Introduction to OOPS: Paradigms of Programming Languages, Basic concepts of Object Oriented Programming, Differences between Procedure Oriented Programming and Object Oriented Programming, Objects and Classes, Data abstraction and Encapsulation, Inheritance, Polymorphism, benefits of OOP , application of OOPs.

Java : History, Java features, Java Environment, JDK, API.

Introduction to Java : Types of java program, Creating and Executing a Java program, Java Tokens, Keywords, Character set, Identifiers, Literals, Separator, Java Virtual Machine (JVM), Command Line Arguments, Comments in Java program.

UNIT -2:

Elements: Constants, Variables, Data types, Scope of variables, Type casting, Operators: Arithmetic, Logical, Bit wise operator, Increment and Decrement, Relational, Assignment, Conditional, Special operator, Expressions – Evaluation of Expressions

Decision making and Branching: Simple if statement, if, else statement, Nesting if, else, else if Ladder, switch statement, Decision making and Looping: While loop, do-While loop, for loop, break, labelled loop, continue Statement, Simple programs

Arrays: One Dimensional Array, Creating an array, Array processing, Multidimensional Array, Vectors, Wrapper classes, Simple programs

UNIT-3:

Strings: Exploring String class, String Class Methods, String Buffer Class, Simple programs

Class and objects: Defining a class, Methods, Creating objects, Accessing class members, Constructors, Static members, Nesting of Methods, this keyword, Command line input.

Polymorphism – Static Polymorphism, Dynamic Polymorphism, Method overloading, Polymorphism with Static Methods, Private Methods and Final Methods.

Inheritance: Defining a sub class, Deriving a sub class, Single Inheritance, Multilevel Inheritance, Hierarchical Inheritance, Overriding methods, Final variables and methods, Final classes, Finalizer methods, Abstract methods and classes, Visibility Control: Public access, Private access, default and protected. Abstract classes.

Interfaces - Interfaces vs Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interfaces. Inner classes **-** uses of inner classes, local inner classes, anonymous inner classes, static inner classes, examples.

UNIT- 4:

Packages: Java API Packages, System Packages, Naming Conventions, Creating & Accessing a Package, Adding Class to a Package, Hiding Classes, Programs

Exception Handling: Limitations of Error handling, Advantages of Exception Handling, Types of Errors, Basics of Exception Handling, try blocks, throwing an exception, catching an exception, finally statement

Multi threading: Creating Threads, Life of a Thread, Defining & Running Thread, Thread Methods, Thread Priority, Synchronization, Implementing runnable interface, Thread scheduling.

I/O Streams: File, Streams, Advantages, The stream classes, Byte streams, Character streams.

JDBC, ODBC Drivers, JDBC ODBC Bridges, Seven Steps to JDBC, Importing java SQL Packages, Loading & Registering the drivers, Establishing connection. Creating & Executing the statement.

UNIT-5:

AWT Components and Event Handlers: Abstract window tool kit, Event Handlers, Event Listeners, AWT Controls and Event Handling: Labels, TextComponent, ActionEvent, Buttons, CheckBoxes, ItemEvent, Choice, Scrollbars, Layout Managers- Input Events, Menus, Programs

Design patterns - Introduction to Creational design patterns, Structural design patterns and Behavioral design patterns.

GUI Programming with Java - Introduction to Swing, limitations of AWT, Swing vs AWT, MVC architecture, Hierarchy for Swing components, Containers - JFrame, JApplet, JDialog, Jpanel. Overview of some swing components Jbutton, JLabel, JTextField, JtextArea, simple swingapplications.

TEXT BOOKS:

1. Java the complete reference, 7 th edition, Herbert Schildt, TMH.

2. Understanding OOP with Java, updated edition, T. Budd, Pearson Education.

REFERENCE BOOKS:

1. An Introduction to programming and OO Design using Java, J.Nino and F.A.

Hosch, John wiley & Sons.

2. Introduction to Java Programming, Y. Daniel Liang, Pearson Education

3. An Introduction to Java programming and Object Oriented Application

Development, R.A. Johnson-Thomson

4. Programming with Java - E. Balagurusamy

5. Object oriented Programming in Java - Dr. G.Thampi

6. Let us Java – Yashavant Kanetkar - BPB Publications, New Delhi - First Edition

2012

7. Core Java, An Integrated Approach, Dr. R. Nageswara Rao

8. An Introduction to Oops with Java - C Thomas WU - TataMc-Graw Hill, New

Delhi - 4th Edition

9. Object oriented Programming through Java - ISRD Group - TataMc-Graw Hill,

New Delhi - Eight Reprint 2011

Outcomes:

After taking the course, students will be able to:

6. Specify simple abstract data types and design implementations, using abstraction functions to document them.
7. Recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
8. Name and apply some common object-oriented design patterns and give

examples of their use.

Design applications with an event-driven graphical user interface.

EC2902 ELECTRONICS MINI PROJECT-II

L-T-P-C

0-0-2-1

Topics:

a. Need to implement any hardware for specific application by using analog, digital components and also microcontrollers.

BM0007 MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

Course Objective:

- Enable the students to learn managerial economics principles applied in industries and equip them to handle the tasks in their career by making a real sense of what is happening economically in the organization.
- The course describes the Nature and Scope of Managerial Economics. It gives complete study on the demand and elasticity of demand and methods of demand forecasting.
- It provides a detailed structure on the pricing strategies and shows clear picture methods and sources of raising finance.
- It gives clear cut information of preparing final accounts and capital Budgeting techniques.

Course Outcome:

After the successful completion of this course, the learner will be able to know:

4. The dynamic game of demand and supply, and how the trinity of Economics i.e. Demand, Supply and Scarcity make the things move around the globe.
5. Principles of Microeconomics applied to industries.
6. Concept of forecasting and applying forecasting techniques to address the challenges and opportunities in the organization they work.
7. Cost and Production analysis, Break-Even analysis, Opportunity Cost, how to optimize organizational resources and how to minimize cost and maximize production, revenue and profit
8. Different pricing structure and discount mechanism suitable for business firms.
9. Market structure and how to exploit market structure for optimizing the benefits of organization.
10. Capital requirements and sources of capital.

UNIT I: Introduction to Managerial Economics:

Definition, Nature and Scope of Managerial Ec
Determinants, Law of Demand and its exceptions.
Significance of Elasticity of Demand. Demand Fo
forecasting, methods of demand forecasting.

UNIT II: Theory of Production and Cost Analysis:

Production Function - Isoquants and Isocosts, MRTS, L
Douglas Production function, Laws of Returns, Internal
Cost Analysis: Cost concepts, Opportunity cost. Fixed
Implicit costs. Out of pocket costs vs. Imputed costs. Bre
of Break-Even Point (simple problems)- Managerial Sig

UNIT III: Markets & Pricing Policies:

Market structures: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. Objectives and Policies of Pricing- Methods of Pricing: Cost Plus Pricing. Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing.

UNIT IV: Introduction to Financial Accounting: Introduction to Financial Accounting: Double entry Book Keeping, Journal, Ledger, Trail Balance and Final Accounts (Trading account, Profit and Loss Account and Balance sheet with simple adjustments).

UNIT V: Capital and Capital Budgeting:

Capital and Capital Budgeting: Capital and its significance. Types of Capital. Estimation of Fixed and Working capital requirements. Methods and sources of raising finance. Nature and scope of capital budgeting, features of capital budgeting proposals. Methods of Capital Budgeting: Payback Method. Accounting Rate of Return (ARR) and Net Present Value Method, Internal Rate of Return (IRR).

Reference Books:

6. Aryasri: Managerial Economics and Financial Analysis, TMH 2009.
7. Varshney &Maheswari : Managerial Economics, Sulthan Chand 2009.
8. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis, Scitech. 2009.
9. V.Rajasekarn &R.Lalitha. Financial Accounting, Pearson Education. New Delhi. 2010
10. Suma Damodaran, Managerial Economics, Oxford University Press. 2009.

EC2801 ANALOG CIRCUITS LAB (only for ECE) **L-T-P-C**

Externals: 60 Marks
Internals: 40 Marks **0-0-2-1**

Course Objectives

6. To design and Characterize of small signal equivalent circuits of BJT, FET and its frequency response.
7. To design differential amplifiers & differential amplifier with active load and its frequency response.
8. To design of simple current mirror circuit using BJT and MOSFET.
9. To design of cascode current mirror circuit using BJT and MOSFET.
10. To design the positive feedback amplifiers for a given specifications and tuned amplifiers & timers.

List of Experiments:

SECTION-A

9. Clipping and Clamping circuits.
10. LC, CLC filters
11. Voltage Regulators.
12. RC-coupled amplifier (single stage & two-stage).
13. Darlington Emitter follower & Tuned voltage amplifier.
14. Power amplifiers (Class-B push pull power amplifier).
15. Feedback amplifiers:
    i. Voltage series feedback amplifier
    ii. Voltage shunt feedback amplifier
    iii. Current shunt feedback amplifier
    iv. Current series feedback amplifier
16. Oscillators:
    i. RC-phase shift oscillator
    ii. Wein-bridge oscillator
    iii. Hartley oscillator
    iv. Colpits oscillator

SECTION-B

Operational Amplifiers

- Parameters of Operational Amplifiers.

- Input bias current, Input Offset current, Input Offset voltage
- Common Mode Rejection Ratio (CMRR)

- Applications of Operational Amplifiers.
  i. Inverting op-amp & Non-Inverting op-amp
  ii. Voltage follower, Summing amplifier
  iii. ZCD, Schmitt trigger
  iv. Full wave precision rectifier etc.
- Wave form generators by using op-amp
  i. Monostable Multi vibrator
  ii. Astable Multi vibrator

Data Converters

- Digital to Analog converters.
  i. Weighted Resistor Type D/A converter
  ii. R-2R ladder Type D/A converter
- Analog to Digital converter.
  1. Single slope & Dual slope A/D converters
  2. Flash type & Successive Approximation Type A/D converters
- Switched capacitor circuit.

Course Outcomes:

3. An ability to design and Characterize of small signal equivalent circuits of BJT, FET and its frequency response.
4. An ability to design differential amplifiers & differential amplifier with active load and it's frequency response.
5. An ability to design of simple current mirror circuit using BJT and MOSFET.
6. An ability to design of cascode current mirror circuit using BJT and MOSFET.
7. An ability to design the positive and negative feedback amplifiers for a given specifications and tuned amplifiers & timers.

Text Books for AC Lab:

8. Electronics Devices and Circuit Theory Boylestad, Robert & Louis, Nashelsky Pearson, 10th Edition
9. Microelectronic Circuits-Theory and applications by Adel S. Sedra and Kenneth C.Smith, Fifth Edition , (Oxford International Student Edition)
10. Electronic Devices and Circuits- Millman and Halkias, TMH
11. Op-Amps and Linear Integrated Circuits Gayakwad , Ramakant A PHI, Learning,4 th Edition Electronic Devices and Circuits Dr. Sharma, Sanjay KATSON,2012

Reference Books for AC Lab:

6. Fundamentals of Electronic Devices and Circuits David, A Bell Oxford Press, 5thEdition, 2008
7. Electronic Principles - with simulation CD Malvino, A.P. Tata McGraw- Hill , Education,7 thEdition
8. Basic Electronics and Linear Circuits Bhargava, N.,Kulshreshtha D., S.Gupta Tata McGraw- Hill Education, 2011
9. Electronics Devices and Circuits Mottershead, Allen PHI Learning,2011
10. Electronic Devices and Circuits- David A Bell - PHI 4th edition

MOOCs for AC lab:

6. https://www.mooc-list.com/course/electronic-systems-and-digitalelectronics-uninettuno?static=true
7. http://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-012-microelectronic-devices-and-circuits-spring-2009/
8. Introductory Analog Electronics Laboratory (Spring 2007) by MIT Open Courseware | Reviews and Ratings.

CS2804 OBJECT ORIENTED PROGRAMMING LAB

Externals: 60Marks

L-T-P-C

Internals: 40Marks

0-0-2-1

OBJECTIVES:

3. To model a object oriented programming using abstract data types, encapsulation, inheritance and polymorphism
4. Practical exposure in Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
5. How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.
6. How to test, document and prepare a professional looking package for each business project using javadoc.

Detailed Contents:

Week-I

1. Write a Java program print "Hello World"

2. Write a Java program that prints all real and imaginary solutions to the quadratic equation

ax2 + bx + c = 0. Read in a, b, c and use the quadratic formula

3. Write a Java program to implement calculator operations

4. Write a java program to find prime factors of given number

5. Write a java program to find whether given number is Palindrome or not

6. Write an application that declares 5 integers, determines and prints the largest and smallest in the group.

Week-II

1. Write a Java program to sort given list of numbers.

2. Write a Java program to implement linear search.

3. Write a Java program to implement binary search.

4. Write a java program to add two given matrices.

5. Write a java program to multiply two given matrices.

6. Write a java program for sorting a given list of names.

7. Write a Java program to give an example for command line arguments.

Week-III

1. Write a program to display details of the required employee based on his Id. The details of employee includes, Emp_name, Emp_age, Emp_gender, Emp_designation, Emp_salary, Emp_Address etc.,

2. A mail-order house sells five products whose retail prices are as follows : Product 1 : Rs. 99.90 , Product 2 : Rs. 20.20 , Product 3 : Rs. 6.87 , Product 4 : Rs. 45.50 and Product 5 : Rs. 40.49 . Each product has Prdouct_Id, Product_Name, Product_Quantity, Product_Price. Write an application that reads a series of pairs of numbers as follows :

a) product Id

b) quantity sold your program use a switch statement to determine the retail price for each product. it should calculate and display the total retail value of all products sold.

3. Write java program that inputs 5 numbers, each between 10 and 100 inclusive. As each number is read display it only if it's not a duplicate of any number already read display the complete set of unique values input after the user enters each new value

4. Write a java program : rolling a pair of dices 10 times [each attempt should be delayed by 10000 ms] and count number Successful attempts. successful attempt : If the pair of Dice results in same values.

5. Implement the following case study using OOP concepts in Java. E-Book stall : Every book has Properties which includes : Book _Name, Book_Author, Book_Count ; Every Customer is having properties as : Customer_Id, Customer_Name, Customer_Address and he can buy Books from E-Book stall. Write a Program which will display the text book name and the remaining count of text books when a customer buys a text book.

Week-IV

1. Write an application that uses String method compareTo to compare two strings defined by the user.

2. Write an application that uses String method equals and equalsIgnoreCase to tests any two string objects for equality.

3. Write an application that uses String method indexOf to determine the total number of occurrences of any given alphabet in a defined text.

4. Write an application that uses String method concat to concatenate two defined strings.

5. Write a Java program to print all vowels in given string and count number of vowels and consonants present in given string

6. Write an application that finds the length of a given string.

7. Write an application that uses String method charAt to reverse the string.

8. Write an application that finds the substring from any given string using substring method and startsWith & endsWith methods.

9. Write an application that changes any given string with uppercase letters, displays it, changes it back to lowercase letters and displays it.

Week-V

1. Write a Java Program to implement Wrapper classes and their methods.

2. Write an application that prompts the user for the radius of a circle and uses a method called circleArea to calculate the area of the circle and uses a method circlePerimeter to calculate the perimeter of the circle.

3. Write a JAVA program for the following a. Call by value b. Call by object

4. Create a class Account with an instance variable balance (double). It should contain a constructor that initializes the balance, ensure that the initial balance is greater than 0.0. Acct details: Acct_Name, Acct_acctno, Acct_Bal, Acct_Address.

Create two methods namely credit and debit, getBalance. The Credit adds the amount (passed as parameter) to balance and does not return any data. Debit method withdraws money from an Account. GetBalance displays the amount. Ensure that the debit amount does not exceed the Account's balance. In that case the balance should be left unchanged and the method should print a message indicating "Debit amount exceeded account balance".

5. Write Java program for the following

a. Example for this operator and the use of this keyword.

b. Example for super keyword.

c. Example for static variables and methods.

Week-VI

1. Write a Java program to find Area and Circle of different shapes using polymorphism concept

2. Write a Java program which can give example of Method overloading and overriding

3. Write an application to create a super class Employee with information first name & last name and methods getFirstName(), getLastName() derive the sub-classes ContractEmployee and RegularEmployee with the information about department, designation & method displayFullName() , getDepartment(), getDesig() to print the salary and to set department name & designation of the corresponding sub-class objects respectively.

4. Derive sub-classes of ContractEmployee namely HourlyEmployee & WeeklyEmployee with information number of hours & wages per hour, number of weeks& wages per week respectively & method calculateWages() to calculate their monthly salary. Also override getDesig () method depending on the type of contract employee.

5. Write an application to create a super class Vehicle with information vehicle number,insurance number,color and methods getConsumption() displayConsumption(). Derive the sub-classes TwoWheeler and FourWheeler with method maintenance() and average() to print the maintenance And average of vehicle.

6. Extend the above TwoWheeler class with methods getType() and getName() which gives the information about the type and the name of the company.Create sub-classes Geared and NonGeared with method average() to print the average of a geared and non-geared two wheeler.

Week-VII

1. Create an abstract class Shape which calculate the area and volume of 2-d and 3-d shapes with methods getArea() and getVolume(). Reuse this class to calculate the area and volume of square ,circle ,cube and sphere.

2. Create an abstract class Employee with methods getAmount() which displays the amount paid to employee. Reuse this class to calculate the amount to be paid to WeeklyEmployeed and HourlyEmployee according to no. of hours and total hours for HourlyEmployee and no. of weeks and total weeks for WeeklyEmployee.

3. Create an Interface payable with method getAmount ().Calculate the amount to be

paid to Invoice and Employee by implementing Interface.

4. Create an Interface Vehicle with method getColor(),getNumber(), getConsumption() calculate the fuel consumed, name and color for TwoWheeler and Four Wheeler By implementing interface Vehicle.

5. Create an Interface Fare with method getAmount() to get the amount paid for fare of travelling. Calculate the fare paid by bus and train implementing interface Fare.

6. Create an Interface StudentFee with method getAmount(),getFirstName(),getLastName() , getAddress(), getContact(). Calculate the amount paid by the Hostler and NonHostler student by implementing interface Student Fee

Week-VIII

1. Write a Program to create your own package. Package should have more than two classes. write a Program that uses the classes from the package.

2. Create a package named org.shapes. Create some classes in the package representing some common geometric shapes like Square, Triangle, Circle and so on. write a Program that uses the classes from the package.

3. Write a Java program to create package called dept. Create four classes as CSE, ECE, ME and CE add methods in each class which can display subject names of your respect year. access this package classes from main class

4. Write a Calculator program : Include all calculator operations in as classes in a Package "Calculator" and import in to main class.

5. Write a program for the following

a. Example to use interfaces in Packages.
b. Example to create sub package in a package.

Week-IX

1. Program for demonstrating the use of throw, throws & finally - Create a class with a main( ) that throws an object of class Exception inside a try block. Give the constructor for Exception a String argument. Catch the exception inside a catch clause and print the String argument. Add a finally clause and print a message to prove you were there.

2. Write a program that shows that the order of the catch blocks is important. If you try to catch a superclass exception type before a subclass type, the compiler should generate errors.

3. Write a program to rethrow an exception – Define methods one() & two(). Method two() should initially throw an exception. Method one() should call two(), catch the exception and rethrow it Call one() from main() and catch the rethrown

4. Exception Handling program for ClassNotFoundException--thrown if a program can not find a class it depends at runtime (i.e., the class's ".class" file cannot be

found or was removed from the CLASSPATH).

5. Exception Handling program for NumberFormatException--thrown if a program is attempting to convert a string to a numerical datatype, and the string contains inappropriate characters (i.e. 'z' or 'Q').

6. Create your own exception class using the extends keyword. Write a constructor for this class that takes a String argument and stores it inside the object with a String reference. Write a method that prints out the stored String. Create a try- catch clause to exercise your new exception.

Week-IX

1. Write a program to create MyThread class with run() method and then attach a thread to this MyThread class object.

2. Write a program where the consumr thread checks the data production status [is over or not] for every 10 ms.

3. Write a Program using Threads to simulate a traffic light. The Signal lights should glow after each 10 second, one by one. For example: Firstly Red, then after 10 seconds, red will be put to off and yellow will start glowing and then accordingly green.

4. Write a Program using Threads for the following case study: Movie Theatre To watch a movie the following process is to be followed, at first get the ticket then show the ticket. Assume that N persons are trying to enter the Theatre hall all at once, display their seuence of entry into theater. Note: The person should enter only after getting a ticket and showing it to the boy.

5. Write a Program using Threads for the following case study: Train Reservation system To reserve a berth the following process need to be followed, at first check the number of available berths with the requested berths, if the number of requested berths are less than or equal to availabe berths then allot berth and print ticket or else display no berths are available. Assume that N persons are trying to reserve the berth, display their sequence of reservation status along with the number of available berths. Note : The person can print ticket only if berth is confirmed.

Week-X

1. Write a program for the following a. display a frame with title MyFrame b. draw a horizontal line. c. Draw one line perpendicular to other. One line parallel to other.

2. Create an application to display a circle within rectangle and fill different colors in the circle & rectangle

3. Write an application that displays any string. Choose color from combo box to change the color of this displayed string and choose its size & type respectively from another two combo boxes.

4. Create a GUI with title STUDENT which has labels roll no., name, course, gender, class, address with textboxes for taking input from the user(without any functionality) and checkboxes for selecting the course, radio buttons for selecting gender with appropriate background color.

Week-XI

1. Write a program to create a frame by creating an object to Jframe class and include close button to terminate the application of the frame.

2. Write a program to create a push button , when the button is clicked an image is displayed in the frame.

3. Write a program to create a menu with several menu items.

4. Create an application Form for University Enroll ment with the following Fields.

a. Check box b. Text area c. List box d. Display text e. Push buttons f. Combo box. g. Radio buttons. h. Back ground color

Week-XII

1. Write a program to insert data into Student Table.

2. Write a program to retrieve the data from the table Student.

OUTCOMES:

CO 1: Be able to analyze and design a computer program to solve real world problems based on

object-oriented principles.

CO 2: Be able to write simple GUI interfaces for a computer program to interact with users, and

to understand the event-based GUI handling principles.

CO 3: A competence to design, write, compile, test and execute straightforward programs using

a high level language.

CO 4: Demonstrate the ability to employ various types of selection constructs in a Java program.

Be able to employ a hierarchy of Java classes to provide a solution to a given set of

requirements.

CO 5: Become familiar with the fundamentals and to acquire programming skills in the Java

language.

V SEMESTER

EC3101 ANALOG AND DIGITAL COMMUNICATIONS

Externals: 60Marks

L-T-P-

C Internals: 40Marks

3-0-0-3 .

UNIT-I: Analog Communications:

Amplitude Modulation schemes: AM, DSBSC, SSBSC and VSB modulation and demodulation. Angle Modulation schemes: FM and PM, Spectral characteristics of angle modulated signals. Super hetrodyne receivers, Frequency Division Multiplexing.

UNIT-II: Noise in analog communication systems:

Gaussian and White noise characteristics, Noise in Amplitude modulation and Angle modulation systems, and SNR calculations. Pre-emphasis and De-emphasis. Threshold effect in angle modulation.

UNIT-III: Pulse modulation:

Sampling process and Quantization, SQNR, A-law and μ-law companding. PAM, PCM, DPCM, DM, ADM, Time Division Multiplexing.

Digital modulation schemes:

ASK, PSK, FSK, QAM and their constellations.

UNIT-IV: Detection Theory:

Gram-Schmidt Orthogonalization, Optimal detection of signals in the presence of noise: MAP rule, ML rule. Matched filter receiver. BER calculations for PCM, ASK, PSK,FSK, QAM in AWGN channel.

UNIT-V: Information theory and coding:

Entropy, Mutual information, Source coding theorem, Channel coding theorem, Huffman code, Repetition code, Hamming code.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

Text Books:

1. Simon Haykin, —Communication Systems, Wiley-India edition, 3 rd edition, 2010

2. B.P. Lathi, & Zhi Ding, —Modern Digital & Analog Communication Systems , Oxford University Press, International 4th edition, 2010.

Reference Books:

1. John G.Proakis& M. Salehi --- Digital Communications, 5th edition, Mc Graw Hill education, 2014.
2. A. Bruce Carlson, & Paul B. Crilly, —Communication Systems – An Introduction to Signals & Noise in Electrical Communication , McGraw-Hill International Edition, 5th Edition, 2010.
3. Herbert Taub & Donald L Schilling, —Principles of Communication Systems , Tata McGraw-Hill, 3rd Edition, 2009.
4. George Kennedy and Bernard Davis, —Electronics & Communication System , TMH, 2004

EC3102 COMPUTER ARCHITECTURE

Externals: 60Marks **L-T-P-C Internals: 40Marks** **3-0-0-3.**

Unit I: Basic Structure of Computers:

Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, addressing mode, Assembly language, Stacks, Queues, Subroutines.

Unit II: Information representation:

Number formats. Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats.

Unit III: Control Design:

Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit.

Unit IV: Memory organization:

Device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

Unit V: I/O organization:

Input - Output systems, Interrupt, DMA, Standard I/O interfaces Concept of parallel processing, Pipelining, Forms of parallel processing.

Course Outcomes: At the end of this course students will demonstrate the ability to

6. Learn how computers work
7. Know basic principles of computer's working
8. Analyze the performance of computers
9. Know how computers are designed and built
10. Understand issues affecting modern processors (caches, pipelines etc.)

Text Books:

6. V.Carl Hammacher, "Computer Organisation", Fifth Edition.
7. A.S.Tanenbum, "Structured Computer Organisation", PHI, Third edition
8. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J., Prentice Hall Edition
9. M.M.Mano, "Computer System Architecture", Edition
10. C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition

11. Hayes J.P, “Computer Architecture and Organization”, PHI, Second edition

EC3103 DIGITAL SIGNAL PROCESSING

Externals: 60Marks
L-T-P-C Internals: 40Marks
3-0-0-3

UNIT I

PART A: Discrete time signals and Systems:

Introduction to DSP, Applications of DSP, Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals;

PART B

Discrete systems attributes, Representation of system with Difference equations and Impulse response calculation, LSI systems, Circular Convolution with examples

UNIT II

PART A: Frequency domain analysis

Review of DTFT, Discrete Fourier Transform (DFT) with Properties, Computation of Linear and circular convolution using DFT, Fast Fourier Transform Algorithm,

PART B

Z transform, ROC, Properties, System description in the frequency domain.

UNIT III

PART A:Digital filters and finite word length effects

Linear Phase filters, Analysis of simple digital filters,Comb filters, all-pass functions, Procedure for stability criteria of discrete systems

PART B:

Effect of finite register length in FIR filter design.

Unit IV

PART A:Digital Filter Structures:

Direct, parallel, cascade, ladder and lattice for Infinite Impulse Response (IIR) filters

PART B

Possible realizations for FIR or Finite Impulse Response filters, including poly phase.

UNIT V

PART A: Design of Digital filters:

Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters, invariant and bilinear transformations

PART B:

Design of FIR Digital filters: Windowmethod, and frequency response sampling techniques

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Represent signals mathematically in continuous and discrete time and frequency domain
2. Get the response of an LSI system to different signals
3. Design of different types of digital filters for various applications

Text/Reference Books:

5. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
6. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
7. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
8. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
9. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992
10. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

EC3104 RF AND MICROWAVE ENGINEERING

Externals: 60Marks

L-T-P-

C Internals: 40Marks

3-0-0-3

Course Objectives:

- To prepare students to understand basic principle of microwave and its applications.
- To prepare students to understand different microwave components and analyzing different type of junctions used in microwave engineering.
- To teach the students about various microwave solid state devices and their characteristics.
- To understand and gain complete knowledge about RF basic concepts, RF filter design.
- To understand and gain complete knowledge about RF amplifier design.

UNIT-I: Introduction to Microwaves:

History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC.

Mathematical Model of Microwave Transmission: Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

UNIT-II: Analysis of RF and Microwave Transmission Lines:

Coaxial line, Rectangular waveguide, Circular waveguide, Resonator, Strip line, Micro strip line.

Microwave Network Analysis: Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters.

UNIT-III: Passive and Active Microwave Devices:

Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator.

Microwave active components: Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

UNIT-IV: Microwave Design Principles:

Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design.

Microwave Antennas: Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas.

UNIT-V: Microwave Measurements:

Power, Frequency and impedance measurement at microwave frequency, Network Analyser and measurement of scattering parameters, Spectrum Analyser and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of Microwave antenna parameters.

Microwave Systems: Radar, Terrestrial and Satellite Communication, Radio Aidsto Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.

Course Outcomes:

6. Able to calculate cut off frequency, identify possible modes and obtain mode characteristics of Reflex Klystron and Gunn oscillator.
7. understand the principles of operation of waveguide, gyrator, isolator attenuator etc. and obtain scattering matrix for various junctions like E-plane, H plane, Circulator, Direction Coupler.
8. Analyze and deign basic microwave amplifiers, particularly klystrons, magnetron, and RF filters, basic RF oscillator and mixer models.
9. Become proficient with microwave measurement of power, frequency and VSWR, impedance for the analysis and design of circuits.
10. Analyze T-R Module, microwave systems and microwave antennas.

Text Books:

6. Microwave devices and circuits-Samuel Y. Liao, Pearson, 3rd Edition, 2003.
7. Microwave principles-Herbert J.Reich, J.G.Skalnik, P.F.Ordung andH.L.Krauss, CBS publishers and distributors, New Delhi, 2004.

References:

6. Foundations for microwave engineering-R.E.Collin, IEEE press, John Wiley, 2nd edition, 2002.
7. Microwave circuits and passive devices-M.L.Sisodia and G.S.Raghuvanshi,Wiley Eastern Ltd., New age International publishers Ltd., 1995.
8. Microwave engineering passive circuits-Peter A.Rizzi, PHI, 1999.
9. Electronic and Radio Engineering-F.E.Terman, McGraw-Hill, 4th Edition, 1995

EC3105 VLSI ENGINEERING

Externals: 60Marks

L-T-P-

C Internals: 40Marks

3-0-0-3

Course Objectives:

1. To study the MOS transistors with their characteristics succeeded by the fabrication process.
2. Making aware of VLSI design flow and gaining knowledge on its basic micron constraints for a panoramic view of transistors
3. Understanding various subsystem design concepts and its internal schematics.
4. Comparison of various programmable logic devices in terms of applications
5. To understand the need for testing a VLSI chip by applying the Engineering skills to meet the challenges in semiconductor industries.

UNIT I: INTRODUCTION

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies-Oxidation, Lithography, Diffusion, Ion implantation, Metallization

Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds, figure of merit o; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT II: VLSI CIRCUIT DESIGN PROCESSES

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 μm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

UNIT III: GATE LEVEL DESIGN

Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Basic circuit concepts, Sheet Resistance RS and its concept to MOS, Area Capacitance Units, Calculations – Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out,Choiceoflayers

Data path subsystem : Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters,.

UNIT IV: SEMICONDUCTOR INTEGRATED CIRCUIT DESIGN

Logic Families: characteristics of digital circuit (Fan-in, Fan-out, power dissipation, propagation delay, noise margin, Figure of Merit etc., Saturated logic families: DCTL, RTL, DTL, HTL, TTL, I2L etc., non-saturated logic families: STTL, ECL. PMOS, NMOS, CMOS.

Array Sub Systems: SRAM, DRAM.

UNIT V: CMOS TESTING

CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level Test Techniques, System-level Test Techniques, Layout Design for improved Testability.

Course Outcomes:
1. Students will be Analyzed with various processing steps involved in IC on monolithic devices followed by understanding MOSFETS electrical properties.
2. Applying the knowledge of layout, stick diagrams, static and switching characteristics of inverters by CMOS technology for designing a sequential circuit.
3. Students will be good at Realizing CMOS as a switch and its technology for designing a combinational circuit by implementing it using transmission gate/PLD's.
4. Students will be knowing the ability to identify, formulate, and analyze by creating an ability to use the techniques, skills and modern EDA tools necessary for design and test of VLSI circuits by keeping aware of contemporary issues.
5. Students will be good at designing VLSI systems by keeping a view on the design for testability concepts.

TEXTBOOKS :
1. Essentials of VLSI circuits and systems – Kamran Eshraghian, EshraghianDougles and A. Pucknell, PHI, 2005 Edition.
2. Principles of CMOS VLSI Design – Weste and Eshraghian, Pearson Education, 1999.

REFERENCES::
1. Chip Design for Submicron VLSI: CMOS Layout & Simulation, – John P. Uyemura, Thomson Learning.
2. Introduction to VLSI Circuits and Systems – John .P. Uyemura, JohnWiley, 2003.
3. Digital Integrated Circuits – John M. Rabaey, PHI, EEE, 1997.
4. Modern VLSI Design – Wayne Wolf, Pearson Education, 3rd Edition, 1997.
5. VLSI Technology – S.M. SZE, 2nd Edition, TMH, 2003.

MAOE

NUMERICAL METHODS

Externals: 60Marks

L-T-P-

C Internals: 40Marks

3-0-0-3

Unit 1: Error in numerical calculations (14 hours)

Sources of errors, significant digits and numerical instability. Solutions of non linear equations: Bisection method, Method of false position, Newton-Raphson method, Fixed-point iteration, Rates of convergence of these methods. Iteration based on second degree equation: Muller method, Chebyshev method, Graeffe's root squaring method for polynomials, Bairstow's method for extracting quadratic factor in the case of polynomial equations.

Unit-II Solution of system of linear algebraic equations: (14 hours)

Direct methods: Gauss and Gauss– Jordan methods. Crout's triangularization method. Iterative methods: Gauss-Jacobi and Gausss-Seidel methods, Relaxation method, Newton's method for nonlinear simultaneous equations, Power method for determination eigen values, convergence of Power method.

Unit –III

Interpolation: Polynomial Interpolation: Lagrange's interpolation, Newton's divided difference interpolation polynomial, Gregory-Newton Forward and Back ward difference interpolation formulae, Piecewise and Spline interpolation.
Numerical integration: Trapezoidal and Simpson rules, Gaussian integration, Errors of integration formulas

Unit-IV

Differentiation formulas in the case of equally spaced points.. Numerical solution of ordinary differential equations: Single step methods: Taylor series method, Picard's Method, Euler and Modified Euler methods, Runge – Kutta methods of 2^{nd} and 4^{th} order. Multi-step methods: Miline's Predictor-Corrector formulas, Adam-Bashforth and Adam-Moulton formulas.

Unit-V:

Solution of Linear difference equations with constant coefficients, Solutions of boundary value problems in ordinary differential equations, Approximate solution of eigen value problems, Finite difference methods for solving two dimensional Laplace's equation for a rectangular region, Finite difference method of solving heat equation and wave equation with given initial and boundary conditions.

References:

1. Froberg C. E., Introduction to Numerical Analysis 2^{nd} edition, Addison Wesley, 1970.
2. Gerald C. F. , Wheatley P.O., Applied Numerical Analysis, 6^{th} edition, Pearson Asia,2002.
3. Jain M.K., IyengarS.R.K., Numerical methods for Scientific and Engineering Computation, 3^{rd} edition, New Age International (P) Ltd, 1996.
4. Phillips G.M., Taylor P.J., Theory and Applications of Numerical Analysis, 2^{nd} edition Academic Press,

EC3701 ANALOG AND DIGITAL COMMUNICATION LAB

Externals: 60Marks

L-T-P-

C Internals: 40Marks

0-0-2-1.

List of Experiments:

1. Amplitude Modulation and Demodulation
2. DSB-SC Modulation and Demodulation

3. Frequency Modulation
4. Frequency division multiplexing
5. PAM, PWM, PPM
6. Automatic Gain Control circuit
7. Carrier recovery circuit
8. Mixer circuit
9. Verification of Sampling theorem
10. Quantizer design
11. PCM implementation
12. ASK,PSK,FSK,QPSK modulation demodulation
13. Decoding of corrupted repetition code
14. Time division multiplexing
15. Using MATLAB, plot the constellation of BPSK, QPSK, without noise and with AWGN (under different SNR values) and draw the decision boundaries. Observe the symbol errors, bit errors.
16. Using MATLAB monte-carlo simulations, to find the BER versus SNR curves for ASK, BPSK, FSK, QPSK, 16 PSK, 16-QAM with AWGN channel.
17. Using MATLAB program, find the Huffman code for given set of samples.

Course Outcomes:

At the end of this lab course, students will able to learn the following:

1. Basic level circuit design for AM, DSBSC, FM, modulator and demodulators
2. Basic level receiver circuit design for analog receivers
3. Digitization of analog signals
4. Various modulation techniques used for digital signal transmission and BER performance
5. Demonstration of Frequency division multiplexing and Time division multiplexing
6. Source coding and Channel coding demonstration

EC3702 DIGITAL SIGNAL PROCESSING LAB

Externals: 60Marks

L-T-P-C Internals: 40Marks

0-0-2-1

Course Objectives:

- To implement Linear and Circular Convolution
- FFT algorithm using MATLAB.
- To implement FIR and IIR filters
- Design of digital filters using MATLAB.
- To study the architecture of DSP processor
- Implementation of digital filters on DSP Processor.

List of Experiments

21. **Experiments on signal processing using MATLAB.**

- Basic matrix operations and Generation of test signals.
- Even and odd parts of the given sequence
- Linear Convolution, circular convolution.
- Interpolation and Decimation
- Discrete Fourier Transform(DFT) and Fast Fourier Transform(FFT)
- Filter Analysis and Implementation.
- Analog Filter Design
- IIR filter design: Butter worth, Chebyshev type 1 and 2: LPF, HPF, BPF & BSF filter.
- FIR filter design using different windows
- Adaptive equalizer, LS, MMSE
- Bayesian, ML estimators

22. **Experiments on DSK and CCS**

- Study of procedure to work in real- time
- Linear Convolution
- Decimation and Interpolation
- Implementation of IIR filters
- Implementation of FIR filter

Course Outcomes:

Students will be able to:

8. Design and analyze the digital filters using MATLAB.
9. Implement FFT algorithms for linear filtering using MATLAB.
10. implement FIR and IIR filters using MATLAB.
11. Design and Implement the digital filters on DSP processor.

References:

- Digital Signal Processing – A Computer Based Approach By Sanjay K. Mitra, Tata McGraw Hill
- Vinay K. Ingle and John G. Proakis, "Digital Signal Processing using MATLAB", 4/e, Cengage learning, 2011.
- B. Venkataramani and M. Bhaskar,"Digital Signal Processor architecture, programming and application", 6/e, TMH, 2006.

EC3703 RF AND MICROWAVE ENGINEERING LAB

Externals: 60Marks

L-T-P-

C Internals: 40Marks

0-0-2-1

Course Objectives:

6. The goal of this course is to introduce students to the concepts and principles of the advanced microwave engineering.
7. To study the characteristics of RKO and Gunn oscillator.
8. Measurement of frequency and wavelengths would be learnt by the student.
9. VSWR various TEES, MHD and Circulator would be understood by the student.
10. Radiation pattern would be learnt by the student for horn antenna.

11. To study the usage of hand held Vector Network Analyzer, Spectrum Analyzer, Advanced Microwave Integrated Circuits.

List of Experiments:

SECTION-A

- Study of standing wave pattern.
- Measurement of guide wavelength and frequency.
  - By using Frequency meter i.e. Direct Method
  - By using Slotted line method i.e. Indirect Method
- Repeller mode characteristics of Reflex klystron.
- I-V characteristics of Gunn Diode.
- Measurement of VSWR.
  - By using Slotted line method (S<10)
  - By using Double minimum method (S>10)
- Calibration of Crystal detector.
- Calibration of Attenuator (Fixed attenuation i.e. Power Ratio method).
- Measurement of attenuator (Variable attenuation i.e. RF substitution method)
- Measurement of unknown impedance.
  - i. By using Load impedance formula
  - ii. By using Smith Chart
- Radiation pattern of horn antenna and parabolic dish antenna.

SECTION-B

Resonant Microwave components

8. Introduction regarding S-parameters (Study Experiment).
9. Characteristics of Magic-Tee with the help of S-matrix and observe the phase difference with the help of CRO.
10. Characteristics of Directional Coupler.
    - i. Directivity
    - ii. Isolation
    - iii. Insertion loss
    - iv. Coupling Factor
    - v. S-matrix
    - vi. And Prove $P^2 + q^2 = 1$.

Non-Resonant Microwave components

11. Characteristics of Circulator (3-port).
    - i. Find S-matrix
    - ii. Find VSWR
12. 4-port Circulator by using two magic tees and one gyrator.
13. Characteristics of Isolator (By using Y-circulator)
    1. Find S-matrix
    2. Find VSWR

.

Course Outcomes:

9. Gain knowledge and understanding of microwave analysis methods.
10. Be able to apply analysis methods to determine circuit properties of passive/active microwave devices.
11. Analyze the characteristics of RKO and Gunn oscillator.
12. Measure the frequency and guided wavelength.
13. Estimate the VSWR for various loads and S-Matrix for various microwave devices.
14. Obtain the horn antenna radiation pattern.

Text Books:

4. Microwave devices and circuits-Samuel Y. Liao, Pearson, 3rd Edition, 2003.
5. Microwave principles-Herbert J.Reich, J.G.Skalnik, P.F.Ordung and H.L.Krauss, CBS publishers and distributors, New Delhi, 2004.
6. Microwave engineering- David M. Pozar, fourth edition, john wiley & Sons Inc. publications.

References:

11. Foundations for microwave engineering-R.E.Collin, IEEE press, John Wiley, 2nd edition, 2002.
12. Microwave circuits and passive devices-M.L.Sisodia and G.S.Raghuvanshi,Wiley

Eastern Ltd., New age International publishers Ltd., 1995.
13. Microwave engineering passive circuits- Peter A.Rizzi, PHI, 1999.
14. Electronic and Radio Engineering- F.E.Terman, McGraw-Hill, 4th Edition, 1995.
15. Microwave and Radar engineering- Dr. M. Kulakarni, Umesh publications, fifth edition, 2015

EC3901 TECHNICAL SEMINAR

L-T-P-C
Total 100 Marks
0-0-2-1

1. Need to present a seminar topic on recent technologies of Electronicsand Communication Engineering

VI SEMESTER

EC3201 DIGITAL SYSTEM DESIGN
Externals: 60Marks
L-T-P-C
Internals: 40Marks
3-0-0-3

UNIT-I:Introduction to Verilog : Evolution of CAD tools,Overview of Design Flow, Modeling Concepts, Modules and Ports, Different Abstractions-Gate level, Dataflow, Behavioral, Tasks and Functions, Useful Modeling Techniques

.

UNIT-II: Advanced Verilog: Timings and Delays, clocking of Flip Flops- effect of Propagation delay by considering timing constraints, clock skew, Global setup and Hold time.

UNIT-III: Basic systems design

Review of FSM- Meelay, Moore Machines, State graphs, State tables, Design of pattern identification, Hardware realizations- Sequential logic, combinational logic and Verilog Modeling, One hot controller-vending machine, Hardware realizations and Verilog Modeling.

UNIT-IV: Sophisticated designs

ASM-components, Meelay ,Moore ASM, Bus Arbiter, Traffic Light Controller, Dice Game, Micro programming techniques-SQDA,SQSA for Dice Game

UNIT-V: **CPLD, FPGA architectures** – Programmable logic devices –FPGA, configurable blocks- LUT.CPLD, functional blocks -Macro cells, Overview of various CPLD, FPGA's.

Text Books:

6. Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition By Samir Palnitkar
7. Jon F Wakerly, Digital Design: Principles and Practices, Prentice Hall.
8. Digital Systems Engineering - E-bok - William J Dally, John W Poulton

References:

7. IIT Madras –Prof S Srinivasan- Nptel Lectures
8. CPLD, FPGA Families .
9. Design & analyze synchronous sequential logiccircuits
10. william i fletcher an engineering approach to digital design

EC3202 MICRO– CONTROLLERS AND INTERFACING

Externals: 60Marks

L-T-P-

C Internals: 40Marks

3-0-0-3

Unit 1: Architecture of Microprocessors:

General definitions of mini computers, microprocessors, micro controllers and digital signal processors. CISC Vs RISC and ARM processors, Overview of 8085 microprocessors.

Unit 2: Architecture and Assembly language of 8086:

Architecture, memory segmentation, signals and pins of 8086 microprocessors. Assembly directives, Addressing modes, Description of Instructions and Assembly software programs with algorithms.

Unit 3: Interfacing with 8086:

Interfacing with peripheral ICs like 8255-PPI, 8237-DMA controller, 8259-Programmable Interrupt Controller, Interfacing with key boards, LEDs, LCDs, ADCs, and DACs etc.

Unit 4: Micro-controller 8051:

Overview of the architecture of 8051 microcontroller, Description of Instructions. Assembly directives. Assembly software programs with Algorithms.

Unit 5: Interfacing with 8051:

Interfacing with keyboards, LEDs, 7 segment LEDs, LCDs, Interfacing with ADCs and DACs, stepper motor etc.

Course Outcomes: At the end of this course students will demonstrate the ability to

1. Do assembly language programming.
2. Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc.
3. Develop systems using microcontrollers

Text Books:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.
4. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.

ECPE1_
PATTERN RECOGNITION
Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

Introduction to pattern recognition with some real world applications, Supervised, unsupervised, Reinforcement learning introduction. Data Pre-processing, Different types of Distance measures and similarity measures. Classification: Bayes Classifier, ML, MAP estimators, Naive Bayes classifier. K-Nearest Neighbor classifier, Support Vector Machines, Kernel Machines, Over-fitting problem, Artificial Neural Networks: Perceptron learning rule, Gradient Descent learning rule. Limitations and where to apply these classification rules. Multi layered perceptron, Back propagation, logic gates using Perceptron, Sigmoid function, Decision trees. Association rules, Apriori algorithm, Rule generation. Clustering, Anomaly Detection, Regression, Dimensionality Reduction techniques: Feature selection, Principle Component analysis, Independent component analysis, Singular Value Decomposition. Evaluating results: Classification metrics, Regression metric, validation, cross- validation.

Course Outcome:

At the end of this course, students will get the ability to
Do preprocessing task and applying suitable classification algorithm for a given classification task.
Apply clustering algorithm for a given data.
Apply regression analysis technique for prediction.
Work with association algorithms.
Represent the data with less number of features.

Reference books:

R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2002.
C.M.Bishop, Neural Networks and Pattern Recognition, Oxford University Press (Indian Edition), 2003.
Pang-Ning Tan, Michael steinbach and Vipin kumar, Introduction to Data mining, Pearson, 2016.
B.Yegnanarayana, Artificial Neural Networks, PHI, 1999.

CS3203

OPERATING SYSTEMS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

OBJECTIVES:

To learn the fundamentals of Operating Systems.

1. To learn the mechanisms of OS to handle processes and threads and their communication

2. To learn the mechanisms involved in memory management in contemporary OS

3. To gain knowledge on distributed operating system concepts that includes architecture,

Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols

4. To know the components and management aspects of concurrency management

Unit 1:

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System

Calls, Structure of an OS – Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.

Unit 2:

Processes: Definition, Process Relationship, Different states of a Process, Process State

transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of

multithreads,

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling

criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time;

Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR

Unit 3:

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion,

Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\

Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing,

Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Unit 4: Memory Management: Basic concept, Logical and Physical address map, Memory

allocation: Contiguous Memory allocation – Fixed and variable partition–

Internal and External fragmentation and Compaction; Paging: Principle of

operation – Page allocation – Hardware support for paging, Protection and sharing,

Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality

of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page

Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not

recently used (NRU) and Least Recently used (LRU).

Unit 5: I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O

Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software,

Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

File Management: Concept of File, Access methods, File types, File operation, Directory

structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation

(linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk

reliability, Disk formatting, Boot-block, Bad blocks

Suggested books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin,

Greg Gagne, Wiley Asia Student Edition.

2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings,

Prentice Hall of India.

Suggested reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin

Publishing

2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley

3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall

of India

4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly

and Associates

Outcomes:

1. Create processes and threads.

2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.

3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.

4. Design and implement file management system.

5. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part ofa uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

BM0003

OPERATIONS RESEARCH

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

Course Objectives:

To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

Unit I: Linear Models

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

Unit II : Transportation Models And Network Models

Transportation Assignment Models – Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

Unit III : Inventory Models

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

Unit IV : Queueing Models

Queueing models – Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

Unit V: Decision Models

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

Course Outcomes:

Upon completion of this course, the students can able to use the optimization techniques for engineering and Business problems

Text Books:

13. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003. REFERENCES: 1. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
14. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 1990.
15. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
16. Hillier and Libeberman, "Operations Research", Holden Day, 1986
17. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
18. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002

EC3801 DIGITAL SYSTEM DESIGN LAB

Externals: 60Marks

L-T-P-C Internals: 40Marks

0-0-2-1

Course Objective:

- Familiarize with VLSI CAD tools like Xilinx14.4 and Mentor Graphics tool.
- Gives Basic concepts of Verilog HDL code to write a code for digital circuits.
- To have hands on experience to design digital circuits, simulate and synthesis the design with Xilinx 14.4 VLSI CAD tool with timing diagrams and RTL diagrams.
- To have hands on experience for transistor level design and simulate it

with transient and dc analysis using mentor Graphics tool.
- FPGA implantation of the Verilog code written in the VLSI CAD tool.

LIST OF EXPERIMENTS:
- Familiarization with Xilinx14.4 tool.
- Simulate and Synthesis of all basis gates.
- Simulate and synthesis of multiplexers, decoders and code converters.
- Simulate and synthesis of all flipflops.
- Simulate and synthesis of Universal shift register.
- Simulate and synthesis of the binary counter, MOD counters.
- FPGA implementation of basic gates and binary counter.
- Familiarization of the mentor Graphic tool for transistor level design.
- Design and synthesis of a CMOS amplifier
- Transient and DC analysis of CMOS inverter.
- Transient, DC and power analysis of the NAND and NOR gates using CMOS implementation.
- Transient, DC and power analysis of the XOR gates using NAND gates cells.
- Transient, DC and power analysis of the 2x1 MUX using NAND gates cell

Course Outcomes:
1. Able to write a Verilog HDL code for the digital systems.
2. Able to use the VLSI CAD tools to design digital systems and get synthesis the design to get RTL level diagram.
3. Able to simulate the digital system to check the functionality with the timing diagrams.
4. Able to do transient and dc analysis of the CMOS Inverter, Logic gates and analog circuits.
5. Able to do FPGA Implementation of the combinational and sequential circuits.

EC3802 MICRO – CONTROLLERS LAB

Externals: 60Marks

L-T-P-C Internals: 40Marks

0-0-2-1

List of Experiment:

Familiarization with TITAN II Kit's hardware and usage of Triton IDE along with Flash Magic for dumping the code to the controller by blinking on board LEDs.

1. Interface simple seven segment LED display with controller.
2. To Display "DEPT OF ECE" on LCD in 8-bit as well as 4-bit mode
3. Interface Keyboard and LCD with controller.
4. Interface Stepper Motor by controlling its direction and make it spin faster or slower.
5. Interface DC motor and control its speed using PWM technique.
6. Design, program and implementTraffic Light system using microcontroller. (prefer the design on breadboard)
7. Design, program and implement Elevatorsystem using microcontroller.

   (prefer the design on breadboard)
8. Interfacing ADC to Microcontroller.
9. Interface DAC with Microcontroller and generate multiple waveforms.
10. Interface Temperature Sensor to ADC and measure it on LCD with microcontroller.

Course Outcomes:
Upon completion of the course the students will have

- Ability to understand the hardware kits and way of dumping the program in IC.
- Gain the knowledge of various input and display output devices and their interfacing to µc-8051.
- Understanding of various motors and ability to interface with microcontrollers in various modes.
- Ability to design and demonstrate various applications such as traffic light controller and elevator control.
- Understanding the interfacing of ADCs and DACs, and various analog sensors.

ECP01 MINI PROJECT

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **0-0-4-2**

ECCV-I Comprehensive Viva-I
Externals: 100Marks **L-T-P-C**
0-0-2-0

ECP02 Summer Internship
Externals: 60Marks **L-T-P-C**
Internals: 40Marks **0-0-2-1**

VII SEMESTER

EC_ Preferable Signal Processing Stream Elective
Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

EC_ Preferable Communication Stream Elective
Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

EC_ Preferable Embedded Systems Stream Elective
Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

BM0010 Professional Law and Ethics
Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

Course Objective: To understand the Legal and Regulatory Framework for doing business in India.
Course Outcome: Students will be able to understand a) Business Laws related to contracts b) Importance of Ethics in Business c) IPR and Legal Aspects.

UNIT - I : Business Ethics Definition - Importance of Ethics in Business - Distinction between Values and Ethics -Characteristics of Ethical Organization - Morality and Professional Ethics - Ethical Dilemmas- How to create an ethical working environment- Ethical Decision making in Business- Role ofcorporate Governance in ensuring ethics in workplace - Indian Ethical Traditions.

UNIT – II: ETHICS IN FUNCTIONAL AREAS OF BUSINESS- Ethics in Marketing: Ethical practices in product packaging and labeling - Pricing - Advertising -Direct marketing – Green marketing - Ethical vs. Unethical marketing behavior. Ethics in HRM:Ethical implications of Privacy – Harassment – Discrimination – Whistle blowing. Ethics inFinance: Accountability – Window dressing and disclosure practices – Insider trading.

UNIT –III: Law of Contract: Nature of Contract and Essential elements of valid contract, Offer and Acceptance, Consideration, Capacity to contract and Free Consent, Legality of Object, Performance and discharge of Contracts, Remedies for breach of contract.

Unit-IV
Contracts-II: Indemnity and guarantee, Contract of Agency, Sale of goods Act -1930: General Principles, Conditions & Warranties, Performance of Contract of Sale.

Unit- V: Law relating to Intellectual Property: Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets;

Suggested readings:

1. Maheshwari & Maheswari - A Manual of Business Laws, Himalaya Publishing House.
2. D. Chandra Bose - Business Law PHI-Private Limited, New Delhi.
3. A.C. Fernando - Business Ethics An Indian Perspective Pearson Education 4.Manuel G. Velasquez - Business Ethics Concepts and Cases Prentice-Hall of India Pvt.Ltd, 2008.
5. S.S. Gulshan - Business Laws Excel Books, New Delhi

ECP03 Project Stage-I
Externals: 60Marks
L-T-P-C
Internals: 40Marks
0-0-6-3

CS4101 COMPUTER NETWORKS

Externals: 60Marks
L-T-P-C
Internals: 40Marks
3-0-0-3

Objectives:

- To Introduce The Fundamental Various Types Of Computer Networks.
- To Demonstrate The TCP/IP And OSI Models With Merits And Demerits.
- To Introduce UDP And TCP Models.

Detailed Contents:

UNIT - I:

Introduction- Hardware And Software, Data Communication, Networking, Protocol, Layering Scenario, TCP/IP Protocol Suite: The OSI Model,Internet History Standards And Administration; Comparioson Of The OSI And TCP/IP Reference Model, Digital And Analog Data And Signals.

Physical Layer: Guided Transmission Media, Wireless Transmission Media.

Data Link Layer: Design Issues, CRC Codes, Elementary Data Link Layer Protocols,

SlidingWindow Protocol, Flow Control. Error Detection And Error Control. HDLC And

other Data Link Protocols.

UNIT - II:

Band Width Utilization: Multiplexing – Frequency-Division, Synchronous Time-Division, And Statistical Time-Division Multiplexing.

Multi Access Protocols: ALOHA, CSMA, Collision Free Protocols, Ethernet-Physical Layer,Ethernet Mac Sub Layer, Data Link Layer Switching & Use Of Bridges, Learning Bridges, Spanning Tree Bridges, Repeaters, Hubs, Bridges, Switches, Routers And Gateways.

UNIT-III:

Network Layer: Network Layer Design Issues, Store And Forward Packet Switching ConnectionLess And Connection Oriented Networks-Routing Algorithms-Optimality Principle, Shortest Path, Flooding, Distance Vector Routing, Control To Infinity Problem, Hierarchical Routing, Congestion Control Algorithms, Admission Control.

UNIT-IV:

Internetworking: Tunneling, Internetwork Routing, Packet Fragmentation, Ipv4, Ipv6 Protocol,IP Addresses, CIDR, IMCP, BOOTP, ARP, RARP, DHCP, Network Address Translation(NAT) Internetworking

Transport Layer: TCP Introduction, Reliable/Un- Reliable Transport ,Connection Establishment, Connection Release, Crash Recovery, Intra-Domain Routing: Distance-Vector, Intra-Domain Routing: Link-State, Wireless Networks: 802.11 MAC, Efficiency Considerations

UNIT-V:

The Internet Transport Protocols: UDP-RPC, Real Time Transport Protocols, The InternetTransport Protocols- Introduction To TCP, The TCP Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Connection Management Modeling, The TCP Sliding Window, The TCP Congestion Control, The Future Of TCP.

Application Layer: Introduction, Providing Services, Applications Layer Paradigms, ClientServer Model, Standard Client-Server Application-HTTP, FTP, Electronic Mail, TELNET, DNS, SSH,SNMP,WWW.

Text Books:

1.Computer Networks, by Andrew s Tanenbaum,PHI(2010)

2.Data and Computer Communications,by William Stallings,PHI(2002)

References Books:

- Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.
- Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.
- An Engineering Approach to Computer Networks - S. Keshav, 2nd Edition, Pearson Edication.
- Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.
- Introduction to Computer Networks and Cyber Security, Chwan-Hwa (John) Wu, J. David Irwin, CRC Press.
- Computer Networks, L. L. Peterson and B. S. Davie, 4th edition, ELSEVIER.
- Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.

Course Outcomes:

- Students should understand and explore the basics of Computer Networks and Various Protocols. He/She will be in a position to understand the World Wide Web concepts.
- Students will be in a position to administrate a network and flow of information further he/she can understand easily the concepts of network security, Mobile and ad hoc networks.

CS4701 COMPUTER NETWORKS LAB

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objectives

6. To understand the working principle of various communication protocols.
7. To analyze the various routing algorithms.
8. To know the concept of data transfer between nodes

Detailed Contents:

Week-1

- Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool.
- Study of Network Devices in Detail.

Week-2

- Study of network IP.
- Connect the computers in Local Area Network.

Week-3

- Study of basic network command and Network configuration commands.
- Socket Program for Echo/Talk commands.

Week-4

- Configure a Network topology using packet tracer software.

Week-5

- Configure Network using Link State Vector Routing protocol.
- Configure a Network using Distance Vector Routing protocol.

Week-6

- Write a program to implement RPC (Remote Procedure Call)
- Write a code simulating PING and TRACEROUTE commands

Week-7

- Implementation of STOP & WAIT protocol and sliding window protocol
- Write a program to implement sub netting and find the subnet masks.

Week-8

- Create a socket for HTTP for web page upload and download.
- Create a socket (UDP)

Week-9

- Using TCP/IP sockets, write a client server program to make client sending the file name and the server to send back the contents of the requested file if present.

Week-10

- Simulation of ARP/RARP

Week-11

- TCP Module Implementation

Week-12

- Applications using TCP and UDP Sockets like d. DNS and SNMP

Course Outcomes

7. Identify and use various networking components Understand different transmission media and design cables for establishing a network
8. Implement any topology using network devices
9. Analyze performance of various communication protocols.
10. Compare routing algorithms
11. Understand the TCP/IP configuration for Windows and Linux
12. Implement device sharing on network
13. Learn the major software and hardware technologies used on computer networks

VIII SEMESTER

EC_
PROGRAM ELECTIVE

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

EC_ OPEN ELECTIVE

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

EC_ OPEN ELECTIVE

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

EC_ OPEN ELECTIVE

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

ECP04 PROJECT STAGE-II

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-16-8**

ECCV-II COMPREHENSIVE VIVA-II

Externals: 100Marks **L-T-P-C**

0-0-2-0

CURRICULUM FOR PROFESSIONAL ELECTIVE SUBJECTS

Credit Distribution for Professional Elective Subjects

Stream-I

Sl. No.	Course Code	Course Title	Semester	Co Ca
1	ECPE1 _	Digital Image Processing	VII	P
2	ECPE1 _	Adaptive Signal Processing	VII	P
3	ECPE1 _	Biomedical Signal Processing	VII	P
4	ECPE1 _	Pattern Recognition	VII	P
5	ECPE1 _	Digital Image and Video Processing	VII	P
6	ECPE1 _	Speech and Audio Processing	VII	P
7	ECPE1 _	Detection and Estimation Theory	VII	P
8	ECPE1 _	Wavelets	VII	P

9	ECPE1	Machine Learning Techniques	VII
10	ECPE1	Deep Learning	VII
11	ECPE1	Multimedia Communication	VII
12	ECPE1	DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES	VII
13	ECPE1	Data Mining	VII
Stream-II			
1	ECPE2 –	Wireless Communications	VII
2	ECPE2 –	Satellite Communication	VII
3	ECPE2 –	Wireless Sensor Networks	VII
4	ECPE2 –	Large MIMO Systems	VII
5	ECPE2 –	Applied Optimization for Wireless, Signal Processing, Machine Learning	VII
6	ECPE2 –	Principles of Signal Estimation for MIMO – OFDM Communications	VII
7	ECPE2 –	Error Correcting Codes	VII

8	PEC	ECPE2 _	Information Theory and Coding	3	0	0	3	VII 3
	PEC			3	0	0	3	3
9		ECPE2	Radar Systems					VII
	PEC			3	0	0	3	3
10	PEC	ECPE2 _	Adhoc Wireless Sensor Networks	3	0	0	3	VII 3
Stream-III	PEC			3	0	0	3	3
1		ECPE3 _	IoT and Applications + (Lab for 1 credit)					VII
2		ECPE3	Embedded Systems					VII
	PEC			3	0	0	3	3
3		ECPE3	Nano Electronics					VII
	PEC			3	0	0	3	3
4		ECPE3	Introduction to MEMS					VII
	PEC			3	0	0	3	3
5		ECPE3	Mixed Signal Design					VII
	PEC			3	0	0	3	3
6		ECPE3	CMOS Design					VII
	PEC			3	0	0	3	3
7		ECPE3 _	Power Electronics					VII
8	PEC	ECPE3 _	High Speed Electronics	3	0	0	3	VII 3
9	PEC	ECPE3 _	Embedded System Design	3	0	0	3	VII 3

10	ECPE3 _	Analog VLSI and Mixed Signal Design	VII	PEC	3	0	0	3	3
11	ECPE3 _	CMOS Analog VLSI Design	VII	PEC	3	0	0	3	3
12	ECPE3 _	CMOS Digital VLSI Design	VII	PEC	3	0	0	3	3
13	ECPE3 _	REAL TIME OPERATING SYSTEMS	VII	PEC	3	0	0	3	3
14	ECPE3 _	CAD for VLSI Circuits	VII	PEC	3	0	0	3	3
15	ECPE3 _	RF Integrated Circuits	VII	PEC	3	0	0	3	3
Stream-IV									
1	ECPE4 _	Fiber Optic Communication	VIII	PEC	3	0	0	3	3
2	ECPE4 _	Antennas and Propagation	VIII	PEC	3	0	0	3	3
3	ECPE4 _	Microwave Theory and Techniques	VIII	PEC	3	0	0	3	3
4	ECPE4 _	Electronic Measurement and Instrumentation	VIII	PEC	3	0	0	3	3

ECPE1_ DIGITAL IMAGE PROCESSING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

Learn and understand the representation of Two Dimensional Linear shift invariant Systems using Matrices

To understand the acquisition of digital images.

Learn and implement the algorithms for basic image processing applications such as image enhancement

Formulate and solve the optimization problems to achieve image restoration from degraded images

To implement, analyze, and asses the performance of the image processing algorithms.

Unit-I: INTRODUCTION:

Mathematical Preliminaries and Two dimensional Systems

Introduction to image Processing and applications of image processing in different fields, Fundamentals of Linear algebra, and Probability, one dimensional and two dimensional Linear shift invariant systems and their representation using matrices, one dimensional and Two Dimensional Convolution, Separable operations using matrices, Two dimensional Discrete time Fourier transform, Two dimensional Z transform and Properties.

Unit-II: Image sampling and Quantization

Sampling of One dimensional signals, Sampling of Two dimensional signals, Anti-aliasing filter, Quantization: Liyod Max quantizer, Uniform quantizer, Signal to quantization noise ratio.

Unit-III: Image Transforms

Unitary transforms and properties, 1D & 2D Discrete Fourier transform, 1D & 2D Discrete cosine transform, 1D & 2D Discrete sine transform, 1D & 2D Discrete Walsh transform, 1D & 2D Discrete Hadamard transform, 1D & 2D Discrete Haar transform, 1D & 2D Discrete KLT transform, Application of KLT for Face recognition.

Unit-IV: Image Enhancement

Point operations: contrast stretching, digital negative, Power law correction, dynamic range compression, intensity level slicing, Thresholding, Bit plane extraction; Histogram equalization and histogram specification; spatial operations:Linear and non linear filtering in spatial domain using spatial masks, Unsharp masking; Transform Operations: Filtering in transform domain; Psuedo coloring

Unit – V: Image Restoration

Classification of restoration methods, Characteristic metrics for Image restoration, Linear and non linear degradation models, Inverse filtering, Pseudo inverse filtering, Wiener filtering: Least squares approach.

Course Outcomes:

To Introduce the applications of the Digital image processing in different research fields, and learn the Mathematical preliminaries required for analyzing two dimensional systems.

Learn the acquisition process of a Digital images

Demonstrated understanding of Image transforms such as Discrete Fourier Transform, Cosine Transform, Hadamard Transform, and KLT.

Demonstrated understanding of image enhancement techniques

Understanding of formulation and solution of image restoration techniques

REFERENCES:

A.K Jain , Fundamentals of Digital Image Proceessing, Prentice Hall.

R. C. Gonzalez, R.E. Woods, Digital Image Processing, Pearson.

ECPE1_ ADAPTIVE SIGNAL PROCESSING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Unit II:

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complexvalued The LMS algorithm (real, complex), convergence analysis, weight errorcorrelation matrix, excess mean square error and mis-adjustment

Unit III:

Variants of the LMS algorithm: the sign LMS family, normalized LMSalgorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering. Signal space concepts - introduction to finite dimensional vectorspace theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, GramSchmidt orthogonalization, concepts of orthogonal projection,orthogonal decomposition of vector spaces.

Unit IV:

Vector space of random variables, correlation as inner product, forward andbackward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Unit V:

Introduction to recursive least squares (RLS), vector space formulation of RLSestimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation.

Mathematically represent the 'adaptability requirement'.

Understand the mathematical treatment for the modeling and design of the signal processing systems.

Text/Reference Books:

S. Haykin, Adaptive filter theory, Prentice Hall, 1986.

C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

EC4435 BIOMEDICAL SIGNAL PROCESSING

Externals: 60Marks (L-T)-P-C

Internals: 40Marks 4-0-3

Course Outcomes:

1. To understand the origin, acqusition and processing of Bio signals and their application for diagnosis, and different Imaging modalities

2. To understand the cardiac and brain signal processing for various applications

3. To learn fundamentals of digital images, and 2 D systems, and various image transforms

4. To learn image enhancement and image restoration methods

5. To learn different classification techniques

Chapter 1:Introduction to bio Signals and Bio images

The Nature of Biomedical SignalsExamples of Biomedical Signals,Origin of bio potenials, The action potential of a cardiac myocyte,The action potential of a neuron,The electroneurogram (ENG),The electromyogram (EMG),The electrocardiogram (ECG).The electroencephalogram (EEG),Event-related potentials (ERPs),The electrogastrogram (EGG),The phonocardiogram (PCG),The carotid pulse,Signals from catheter-tip sensors,The speech signal,The vibromyogram (VMG),The vibroarthrogram (VAG),Otoacoustic emission (OAE) signals,Bioacoustic signals. Biomedical images: Different imaging modalities, Computer aided Tomography

Chapter 2: Cardiac and Brain signal Processing

Acqusition of ECG: Standard 12 lead system, ambugulatory ECG signal, Fundamental Prolems of Cardiac signal Processing, Pre processing techniques, QRS detection: Categorisation, Pam Tompkins technique, Automatic heart beat classification, AAMI standard, Review of methods of heart beat classification,

Chapter 3:

Digital image acquisition, sampling and quantization, Response of 1D LSI system for non-periodic and periodic inputs (Using matrix method), Response of Two dimensional LSI systems for non periodic and periodic inputs using row ordered vector form of images, Image transforms: Unitary transforms and properties, Discrete Fourier transform, Discrete Cosine transform, Discrete sine transform, Walsh transform, Hadmard transform, Haar transform, KL transform

Chapter 4:

Image enhancement: Point processing techniques: Contrast stretching, dynamic range compression, Power law correction, Bit plane slicing, Gray level slicing, thresholding, Hisogram equalization, Histogram matching, Neighbour hood processing: LSI filtering, Low pass filters, High pass filters: First order and second order derivative filtes, High boost filtering, Frequency domain processing

Image Restoration: Difference between Image restoration and Image enhancement, Performance metrics, Simplifies model for degradation using LSI approximation, methods of estimation of degradation function, Models for different degradations, Inverse filtering, effect of noise on inverse filtering: Least sqaures filtering, Constrained Least squares filtering, Weiner filtering

Chapter 5:

Data preprocessing, Feature extraction methods, Regression, Classification: Supervised and Unsupervised learning, Nearest neighbour classification, Bayesian classifier, K Nearest neighbour classification, Support vector machine, Artifical neural networks, K means clustering,

Reference Books:

1. “BIOMEDICAL SIGNAL ANALYSIS”, RANGARAJ M. RANGAYYAN, IEEE press, Wiley

2. “Fundamentals of Digital image processing” by A.K Jain, PhI

3. “Digital image processing”, R. Gonzalez and Woods

ECPE1_ PATTERN RECOGNITION

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Introduction to pattern recognition with some real world applications, Supervised, unsupervised, Reinforcement learning introduction. Data Pre-processing, Different types of Distance measures and similarity measures. Classification: Bayes Classifier, ML, MAP estimators, Naive Bayes classifier. K-Nearest Neighbor classifier, Support Vector Machines, Kernel Machines, Over-fitting problem, Artificial Neural Networks: Perceptron learning rule, Gradient Descent learning rule. Limitations and where to apply these classification rules. Multi layered perceptron, Back propagation, logic gates using Perceptron, Sigmoid function, Decision trees. Association rules, Apriori algorithm, Rule generation. Clustering, Anomaly Detection, Regression, Dimensionality Reduction techniques: Feature selection, Principle Component analysis, Independent component analysis, Singular Value Decomposition. Evaluating results: Classification metrics, Regression metric, validation, cross-validation.

Course Outcome:

At the end of this course, students will get the ability to

Do preprocessing task and applying suitable classification algorithm for a given classification task.

Apply clustering algorithm for a given data.

Apply regression analysis technique for prediction.

Work with association algorithms.

Represent the data with less number of features.

Reference books:

R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2002.
C.M.Bishop, Neural Networks and Pattern Recognition, Oxford University Press (Indian Edition), 2003.
Pang-Ning Tan, Michael steinbach and Vipin kumar, Introduction to Data mining, Pearson, 2016.
B.Yegnanarayana, Artificial Neural Networks, PHI, 1999.

ECPE1_ DIGITAL IMAGE AND VIDEO PROCESSING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Digital Image Fundamentals-Elements of visual perception, image sensing andacquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Unit II:

Image Enhancements and Filtering-Gray level transformations, histogramequalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Unit III:

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Image Segmentation- Detection of discontinuities, edge linking and boundarydetection, thresholding – global and adaptive, region-based segmentation.

Unit IV:

Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

Unit V:

Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.

Fundamentals of Video Coding- Inter-frame redundancy, motion estimationtechniques – fullsearch, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation- Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Mathematically represent the various types of images and analyze them.

Process these images for the enhancement of certain properties or for optimized use of the resources.

Develop algorithms for image compression and coding

Text/Reference Books:

R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008

Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004

Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

ECPE1_ SPEECH AND AUDIO PROCESSING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Introduction- Speech production and modeling - Human Auditory System;General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness. Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters,convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Unit II:

Linear Prediction of Speech- Basic concepts of linear prediction; LinearPrediction Analysis of non-stationary signals – prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Unit III:

Speech Quantization- Scalar quantization–uniform quantizer, optimum quantizer,logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Unit IV:

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

Unit V:

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zerostate method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Mathematically model the speech signal

Analyze the quality and properties of speech signal.

Modify and enhance the speech and audio signals.

Text/Reference Books:

"Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students Edition), 2004.

"Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

ECPE1_ DETECTION AND ESTIMATION THEORY

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

To enable the students to acquire the fundamental concepts of Signal detection and estimation

To expose the conceptual basics of Hypotheses.

To introduce the methods of Detection and estimation of signals in white and non-white Gaussian noise.

To familiarize with the detection of random signals.

To enable the students to understand the time varying waveform detection and its estimation.

UNIT –I: Random Processes

Discrete Linear Models, Markov Sequences and Processes, Point Processes,and Gaussian Processes.

UNIT –II: Detection Theory

Basic Detection Problem, Maximum A posteriori Decision Rule,Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)-minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

UNIT –III: Linear Minimum Mean-Square Error Filtering

Linear Minimum Mean Squared Error stimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with tored Data, Real-time Digital Wiener Filters, Kalman Filters.

UNIT –IV: Statistics

Measurements, Nonparametric Estimators of Probability Distribution and DensityFunctions,Point Estimators of Parameters, Measures of the Quality of Estimators, Introductionto Interval stimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression,Multiple Linear Regression.

UNIT –V: Estimating the Parameters of Random Processes from Data

Tests for Stationarity andErgodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Special Density Functions.

TEXT BOOKS:

Random Signals: Detection, Estimation and Data Analysis - K. Sam Shanmugan&A.M.Breipohl, Wiley India Pvt. Ltd, 2011.

Random Processes: Filtering, Estimation and Detection - Lonnie C. Ludeman, Wiley India Pvt. Ltd., 2010.

REFERENCES:

Fundamentals of Statistical Signal Processing: Volume I Estimation Theory– Steven.M.Kay,Prentice Hall, USA, 1998.

Fundamentals of Statistical Signal Processing: Volume I Detection Theory– Steven.M.Kay,Prentice Hall, USA, 1998.

Introduction to Statistical Signal Processing with Applications - Srinath, Rajasekaran,Viswanathan, 2003, PHI.

ECPE1_ WAVELETS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Introduction to time frequency analysis; the how, what and why about wavelets, Short-time Fourier transform, Wigner-Ville transform.;Continuous time wavelet transform, Discrete wavelet transform, tiling of the time-frequency plane and wave packet analysis, Construction of wavelets. Multiresolution analysis. Introduction to frames and biorthogonal wavelets, Multirate signal processing and filter bank theory, Application of wavelet theory to signal denoising, image and video compression, multi-tone digital communication, transient detection.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand time-frequency nature of the signals.

Apply the concept of wavelets to practical problems.

Mathematically analyze the systems or process the signals using appropriate wavelet functions.

Text/Reference Books:

Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.

I. Daubechies, Ten Lectures on Wavelets, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1992.

C. K. Chui, An Introduction to Wavelets, Academic Press Inc., New York, 1992.

Gerald Kaiser, A Friendly Guide to Wavelets, Birkhauser, New York, 1995.

P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.

A.N. Akansu and R.A. Haddad, Multiresolution signal Decomposition: Transforms, Subbands and Wavelets, Academic Press, Oranld, Florida, 1992.

B.Boashash, Time-Frequency signal analysis, In S.Haykin, (editor), Advanced Spectral Analysis, pages 418--517. Prentice Hall, New Jersey, 1991.

EC4503 MACHINE LEARNING TECHNIQUES 4L-0-0-3 (3 credits)

Course Objectives:

- To introduce students to the basic concepts and classical techniques of Machine Learning.
- To study optimization algorithms used in Machine learning.
- To study various classification techniques, regression, clustering, ANN.
- To study Deep learning concepts: CNN, RNN and hyper parameter tuning, some case studies.

UNIT-1(Introduction):

Introduction to Machine Learning: Supervised learning, Unsupervised learning, Reinforcement learning. Machine Learning applied to AI examples. Structured data, Unstructured data, training data, test data, cross validation, data collection (Unbiased data), data cleaning, feature extraction, Properties of best features for classification. Linear Regression, Logistic Regression. Over fitting problem. Bias-Variance tradeoff.

UNIT-2(Classical Techniques of ML):

Error metrics, error metrics for skewed classes, Gradient Descent algorithms: Batch, mini-batch, Stochastic Gradient descent.
Classification Techniques: Bayes classifier, Naïve Bayes classifier, K-Nearest neighbor, Perceptron learning algorithm, Multi-layer Perceptron, Regularization, Support Vector Machines, Decision tree algorithm.
Clustering: K-means clustering
Dimensionality Reduction, Anomaly detection.

UNIT-3(Artificial Neural Networks):

Introduction to Neural networks**,** back propagation algorithm. Activation functions: Sigmoid, tanh, ReLU, SoftMax.Regularization techniques.

UNIT-4(CNN)

Deep learning, vanishing gradients problem, Hyper parameters.
CNN and applications to Computer Vision.
Hyper parameters tuning.
Case studies: LeNet-5, AlexNet, VGG-16, ResNets
Self-driving car application.
Generative Adversial Networks (GAN)

UNIT-5(RNN)

RNN and application to sequence modeling. Hyper parameters tuning.

Some Case studies.

Course Outcomes:

At the end of the course, students will learn the various algorithms related to Supervised Learning, Unsupervised learning, Deep learning concepts.

Text Books:

1. Deep Learning, Goodfellow et al, MIT Press
2. and Machine Learning, Christopher Bishop, Springer

Reference MOOCs:

- “Machine Learning” by Prof.Andrew NG, Coursera (Stanford)
- “Deep Learning” by Prof.Andrew NG, Coursera (Stanford)

EC4432 MULTIMEDIA COMMUNICATION
Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives

- The course is designed
- To provide an introduction to the fundamental principles and techniques in Multimedia Signal coding and compression.
- To give an overview of current multimedia standards and technologies.
- To provide techniques related to computer and multimedia networks.
- To provide knowledge related to Multimedia Network Communications and Applications.

Course Outcomes

- Upon completing the course, the student will be able to:
- Understand the fundamentals behind multimedia signal processing.
- Understand the fundamentals behind multimedia compression.
- Understand the basic principles behind existing multimedia compression and communication standards.
- Understand future multimedia technologies.
- Apply the acquired knowledge to specific multimedia related problems and projects at work.
- Take advanced courses in this area.

UNIT -I

Introduction to Multimedia: Multimedia, World Wide Web, Overview of Multimedia Tools, Multimedia Authoring, Graphics/Image Data Types, and File Formats.

Color in Image and Video: Color Science — Image Formation, Camera Systems, Gamma Correction, Color Matching Functions, CIE Chromaticity Diagram, Color Monitor Specifications, Out-of-Gamut Colors, White Point Correction, XYZ to RGB Transform, Transform with Gamma Correction, L*A*B* Color Model. Color Models in Images — RGB Color Model for CRT Displays, Subtractive Color: CMV Color Model, Transformation from RGB to CMV, Under Color Removal: CMYK System, Printer Gamuts, Color Models in Video — Video Color Transforms, YUV Color Model, YIQ Color Model, Ycbcr Color Model.

UNIT -II

Video Concepts: Types of Video Signals, Analog Video, Digital Video.

Audio Concepts: Digitization of Sound, Quantizatiofl and Transmission of Audio.

UNIT -III

Compression Algorithms

Lossless Compression Algorithms: Run Length Coding, Variable Length Coding, Arithmetic Coding, Lossless JPEG, Image Compression.

Lossy Image Compression Algorithms: Transform Coding: KLT And DCT Coding, Wavelet Based Coding.

Image Compression Standards: JPEG and JPEG2000.

UNIT – IV

Video Compression Techniques: Introduction to Video Compression, Video Compression Based on Motion Compensation, Search for Motion Vectors, H.261- Intra-Frame and Inter-Frame Coding, Quantization, Encoder and Decoder, Overview of MPEG 1 and MPEG2.

UNIT -V

Audio Compression Techniques: ADPCM in Speech Coding, G.726 ADPCM, Vocoders Phase Insensitivity, Channel Vocoder, Formant Vocoder, Linear Predictive Coding, CELP, Hybrid Excitation Vocoders, MPEG Audio — MPEG Layers, MPEG Audio Strategy, MPEG Audio Compression Algorithms, MPEG-2 AAC, MPEG-4 Audio.

TEXT BOOKS

Fundamentals of Multimedia — Ze- Nian Li, Mark S. Drew, PHI, 2010.

Multimedia Signals & Systems — Mrinal Kr. Mandal Springer International Edition 1St Edition, 2009

REFERENCE BOOKS

Multimedia Communication Systems — Techniques, Stds&Netwroks KR. Rao, Zorans. Bojkoric, DragoradA.MjIovanj 1st Edition, 2002.

Fundamentals of Multimedia Ze- Man Li, Mark S.Drew, Pearson Education (LPE), 1st Edition, 2009.

Multimedia Systems John F. KoegelBufond Pearson Education (LPE), 1st Edition, 2003.

Digital Video Processing — A. Murat Tekaip, PHI, 1996.

Video Processing and Communications — Yaowang, JornOstermann, Ya-QinZhang, Pearson,2002

EC4433 DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To introduce architectural features of programmable DSP Processors of TI and AnalogDevices.
- To recall digital transform techniques.
- To give practical examples of DSP Processor architectures for better understanding.

- To develop the programming knowledge using Instruction set of DSP Processors.
- To understand interfacing techniques to memory and I/O devices.

Course Outcomes:

- Student will be able to:
- To distinguish between the architectural features of general purpose processors and DSP processors
- Understand the architectures of TMS 320C54XX and ADSP2100 DSP devices
- Able to write assembly language programs using instruction set of TMS320C54XX
- Can interface various devices to DSP Processors

UNIT-I: Introduction to Digital Signal Processing:

Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolationComputational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT-II: Architectures for Programmable DSP Devices:

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT-III: Programmable Digital Signal Processors:

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.

UNIT-IV: Analog Devices Family of DSP Devices:

Analog Devices Family of DSP Devices – ALU and MAC block diagram, ShifterInstruction,Base Architecture of ADSP 2100, ADSP-2181 high performance Processor. introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

UNIT-V: Interfacing Memory and I/O Peripherals to Programmable DSP Devices:

Memory space organization, External bus interfacing signals, Memory interface, ParallelI/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TEXT BOOKS:

Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.

A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009

Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

REFERENCES:

Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.

Digital Signal Processing – Jonatham Stein, 2005, John Wiley.

DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.

Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI

The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D.,California Technical Publishing, ISBN 0-9660176-3-3, 1997 6.Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005.

EC4502 DATA MINING
Externals: 60Marks
(L-T)-P-C

Internals: 40Marks
4-0-3

Objectives:

- To impart an introduction to Data Mining.
- To develop basic knowledge of how data is transformed to Data Warehouses.

UNIT - I:

Introduction to Data Mining: What is data mining? Related technologies - Machine Learning, DBMS, OLAP and Statistics. Data Mining Goals, Stages of the Data Mining Process , Data Mining Techniques. Knowledge Representation Methods, Applications. Example: weather data **Data Warehouse and OLAP:** Data Warehouse and DBMS, Multidimensional data model , OLAP operations, Example:loan data set.

UNIT - II:

Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies.
Data mining knowledge representation: Task relevant data, Background knowledge, Interestingness measures, Representing input data and output knowledge
Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures

UNIT - III:

Data mining algorithms: Association rules - Motivation and terminology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis.
Data mining algorithms: Classification - Basic learning/mining tasks, Bayesian, Naïve Bayes , Decision trees, Covering rules, Random Forest.

UNIT - IV:

Data mining algorithms: Prediction - The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), Linear models
Evaluating what's been learned: Basic issues, Training and testing, Estimating classifier accuracy (holdout, cross-validation, leave-one-out), Combining multiple models (bagging, boosting, stacking), Minimum Description Length Principle (MLD)

UNIT - V:

Clustering: Basic issues in clustering, First conceptual clustering system: Cluster/2 , Partitioning methods: k-means, expectation maximization (EM), Hierarchical methods: distance-based agglomerative and divisible clustering
Basics of ANN, Perceptron, MLP

Suggested References:

- I. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2000.
- J. Han and M. Kamber. Data Mining: Concepts and Techniques, 2nd Ed. Morgan Kaufman. 2006.
- M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education. 2001.
- D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001.
- Pang-Ning Tan, Michael Steinbach, Vipin Kumar. Introduction to Data Mining. Addison- Wesley Longman Publishing Co.

ECPE1_ WIRELESS COMMUNICATIONS
Externals: 60Marks **(L-T)-P-C**
Internals: 40Marks **4-0-3**

Course objectives:

6. To provide the students with the fundamental theoretical and practical concepts of wireless communication
7. To equip the students with various kinds of wireless networks and its operations.
8. To prepare the students to understand the concept of frequency reuse and be able to apply it in the design of mobile cellular system
9. To prepare the students to understand various multiple access techniques that are used in wireless communications
10. To train the students to understand the basic concepts of OFDM and MIMO.
11.

Course outcomes:

6. On successful completion of this course, the students should be able to:
7. Select appropriate value of C/I to design the Antenna system
8. Analyze the characteristics of different setups for the wireless communication using new models for the coverage improvement.
9. Select different technologies to solve numerical problems using multiple access technique.
10. Demonstrate the technical aspects of diversity for wireless communication.
11. Understand the basic PAPR problem in OFDM and understanding basic concepts in SIMO.

UNIT - I

Basic Cellular system and its operation: frequency reuse, channel assignment strategies, Handoffprocess, factors influencing handoffs, handoffs in different Generations, Interference and system capacity, Crosstalk, Enhancing capacity and cell coverage, Trunked radio system, grade of service as per Erlang's B system.

UNIT – II

Propagation models: Free space propagation model, three basic propagation mechanisms, practical linkbudget design using path loss models, outdoor propagation models: Ground reflection (2-ray) Model, log normal shadowing, Okumura model, Hata model and indoor propagation model. Rayleigh fading, BER in Rayleigh fading channel with BPSK transmission,doppler spread, rms delay spread, Coherence time and Coherence bandwidth of wireless channel.

UNIT – III

Basic equalizers: LS, MMSE estimators for channel, Multiple Access Techniques:

FDMA, TDMA, CDMA, RAKE receiver, SDMA.

UNIT – IV

SIMO: Diversity, SIMO (multiple receive antennas) model, maximal ratio combining (MRC) receiver, BER with MRC (high SNR approximation), diversity order.

UNIT – V

OFDM: Multicarrier basics, OFDM transmitter and receiver blocks, cyclic prefix in OFDM, PAPR problem in OFDM, SC-FDMA transmitter and receiver blocks.

Text Books:

Theodore.S. Rappaport, “Wireless Communications: Principles and Practice”, 2/e, Pearson Education, 2010

Aditya K Jagannatham, “Principles of Modern Wireless Communication Systems”, Mc-Graw Hill

Suggested Reading:

David Tse and Pramod Viswanath, “Fundamentals of Wireless Communications”,Cambridge University Press.

EC4403 SATELLITE COMMUNICATIONS

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

5. To prepare the student to excel in basic knowledge of satellite communication principles.
6. To provide students with solid foundation in orbital mechanics and launches for the satellite communication
7. To train the students with the basic knowledge of link design of satellite with a design examples.
8. To provide the better understanding of multiple access systems and earth station technology.
9. To prepare the students with knowledge in satellite navigation and GPS and satellite packet communication

Course Outcomes:

6. At the end of this course Students will be able to
7. Explain, basic concepts and frequency allocations for satellite communications.
8. Describe the orbital mechanics, launch vehicles and launchers.

9. Design satellite links for specified C/N.
10. Visualize satellites sub systems like telemetry, tracking, command and monitoring power systems etc.,
11. Explain the different multiple access systems and their need in satellite communications and GPS Receivers,.

UNIT-I: Communication Satellite Orbit and Description

A Brief history of satellite Communication, satellite Frequency Bands, Satellite Systems, Applications, Orbital Period and Velocity, effects of orbital Inclination, Azimuth and Elevation, Coverage angle and slant Range, Eclipse, Orbital Perturbations,Placement of a Satellite in a Geo-Stationary orbit.

UNIT-II: Satellite Sub-Systems

Attitude and Orbit Control system, TT&C subsystem, Attitude Control subsystem,Power systems, Communication subsystems, Satellite Antenna Equipment.Satellite Link: Basic Transmission Theory, System Noise Temperature and G/T ratio, Basic LinkAnalysis, Interference Analysis, Design of satellite Links for a specified C/N, (With and without frequency Re-use), Link Budget

UNIT-III: Propagation Effects

Introduction, Atmospheric Absorption, Cloud Attenuation, Tropospheric and Ionospeheric Scintillation and Low angle fading, Rain induced attenuation, rain induced cross polarization interference. Multiple Access : Frequency Division Multiple Access (FDMA) - Intermodulation, Calculation of C/N, Time Division Multiple Access (TDMA) -Frame Structure, Burst Structure, Satellite switched TDMA, On-board Processing, Demand Assignment Multiple Access (DAMA) – Typesof Demand Assignment, Characteristics, CDMA Spread Spectrum Transmission and Reception.

UNIT-IV: Earth Station Technology

Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface,Power Test Methods, Lower Orbit Considerations. Satellite Navigation and Global Positioning Systems:Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers, GPS C/A Code Accuracy, Differential GPS.

UNIT-V: Satellite Packet Communications

Message Transmission by FDMA: M/G/1 Queue, Message Transmission by TDMA, PURE ALOHA-Satellite Packet Switching, Slotted Aloha, Packet Reservation, Tree Algorithm.

TEXT BOOKS:

1. Satellite Communications –Timothy Pratt, Charles Bostian, Jeremy Allnutt, 2ndEdition,

2003,john Wiley & Sons.

2. Satellite Communications Engineering – Wilbur, L. Pritchand, Robert A. Nelson and Heuri

G.Suyderhoud, 2ndEd., Pearson Publications.

3. Digital Satellite Communications-Tri.T.Ha, 2ndEdition, 1990, Mc.Graw Hill.

REFERENCES:

1. Satellite Communications-Dennis Roddy, 2ndEdition, 1996, McGraw Hill.

2. Satellite Communications: Design Principles –M. Richcharia, 2ndEd., BSP, 2003.

3.Digital Satellite Communications –Tri. T. Ha, 2ndEd., MGH, 1990.

4. Fundamentals of Satellite Communications –K. N. Raja Rao, PHI, 2004.

ECPE1_ WIRELESS SENSOR NETWORKS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

Unit II:

Mobile Ad-hocNetworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

Unit III:

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee,

Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

Unit IV:

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

Unit V:

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.

Course Outcomes:

At the end of the course the students will be able to

Design wireless sensor networks for a given application

Understand emerging research areas in the field of sensor networks

Understand MAC protocols used for different communication standards used in WSN

Explore new protocols for WSN

Text/Reference Books:

Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications ,2011

Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009

Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier Publications,2004

Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science

Philip Levis, And David Gay "TinyOS Programming” by Cambridge University Press 2009

ECPE1_

LARGE MIMO SYSTEMS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

- To study the various concepts of MIMO communication.
- To study Large MIMO systems encoding and decoding techniques.
- To study MIMO channel models and MIMO channel estimation.

Unit-I:

Introduction: Multi-antenna wireless channels, MIMO system model, MIMO communication with CSIR-only, Slow fading channels, Fast fading channels, MIMO communication with CSIT and CSIR, Increasing spectral efficiency: quadrature amplitude modulation (QAM) vs MIMO, Multiuser MIMO communication.

Large MIMO systems: Opportunities in large MIMO systems, Channel hardening in large dimensions, Technological challenges and solution approaches.

Unit-II:

MIMO encoding: Spatial multiplexing, Space-time coding, Space-time block codes, High-rate NO-STBCs, NO-STBCs from CDAs, Spatial modulation (SM).

MIMO detection: System model, Optimum detection, Linear detection, Interference cancellation, LR-aided linear detection, Sphere decoding

Unit-III:

Detection based on local search, Detection based on probabilistic data association (PDA), Detection/decoding based on message passing on graphical models, Detection based on MCMC techniques.

Unit-IV:

Channel estimation in large MIMO systems, MIMO capacity with imperfect CSI, Point-to-point MIMO training, Multi-user MIMO training, Large multi-user MIMO systems, Iterative channel estimation/detection in frequency-flat fading, Iterative channel estimation/equalization in ISI channels, Equalization using initial channel estimates, Equalization using the MGS-MR algorithm.

Precoding in point-to-point MIMO, Precoding in a multiuser MIMO downlink, Precoding in large multiuser MISO systems, Multicell precoding

Unit-V:

MIMO channel models: Analytical channel models, Spatial correlation based models, Propagation based models, Effect of spatial correlation on large MIMO performance: an illustration, Pinhole effect, Effect of spatial correlation on LAS detector performance, Standardized channel models, Models in IEEE 802.11 WiFi, Models in 3GPP/LTE, Large MIMO channel measurement campaigns, Compact antenna arrays, PIFAs as elements in compact arrays, MIMO cubes

Text Books:

1. A.Chockalingam and B.Sundar Rajan, “Large MIMO Systems”, Cambridge University Press, 2014.

Reference Books:

1. D. Tse and P. Viswanath, Fundamentals of Wireless Communication. Cambridge, UK: Cambridge University, 2005.

2. H. Jafarkhani, Space-Time Coding: Theory and Practice. Cambridge, UK: Cambridge University Press, 2005.

ECPE1_ Applied Optimization for Wireless, Signal Processing, Machine Learning

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

1. To study the concepts of local minima and global minima, and study of some Numerical optimization techniques.

2. To study the Convex optimization concepts.

3. To study the formulation and solving various optimization problems related to Wireless communications, signal processing and Machine learning.

Unit-I:
Introduction to properties of Vectors, Norms, Positive Semi-Definite matrices, Gaussian Random
Vectors, Local minimum, global minimum, Optimization Problem formulation examples: Bus terminus problem, Transportation problem, regression problem. Steepest Descent algorithm.

Unit-II:
Introduction to Convex Optimization – Convex sets, Hyperplanes/ Half-spaces etc. Application: Power constraints in Wireless Systems, Convex/ Concave Functions, Examples, Conditions for Convexity. Application: Beamforming in Wireless Systems, Multi-User Wireless, Cognitive Radio Systems, Convex Optimization problems, Linear Program, Application: Power allocation in Multi-cell cooperative OFDM

Unit-III:
SOCP Problems, Application: Channel shortening for Wireless Equalization, Robust Beamforming in Wireless Systems, Duality Principle and KKT Framework for Optimization. Application: Water-filling power allocation, Optimization for MIMO Systems, OFDM Systems and MIMO-OFDM systems

Unit-IV:
Optimization for signal estimation, LS, WLS, Regularization. Application: Wireless channel estimation, Image Reconstruction-Deblurring, Application: Convex optimization for Machine Learning, Principal

Component Analysis (PCA), Support Vector Machines

Unit-V:

Application: Cooperative Communication, Optimal Power Allocation for cooperative Communication, Application: Compressive Sensing, Sparse Signal Processing, OMP (Orthogonal Matching Pursuit), LASSO (Least Absolute Shrinkage and Selection Operator) for signal estimation

Text Books:

1. Stephen Boyd, Convex Optimization, Cambridge University Press.

Reference Books:

1. Convex Optimization Algorithms, by Dimitri P. Bertsekas, 2015, Athena scientific

Reference NPTEL MOOCs:

Applied Optimization for Wireless, Machine Learning, Big-Data by Prof. Aditya K. Jagannatham

ECPE1_ Principles of Signal Estimation for MIMO/OFDM Wireless Communications

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

1. To study the ML estimation concept.

2. To study the MMSE estimation concept.

3. To study the estimation problems related to wireless sensor network, wireless fading channel, channel equalizer, OFDM.

Unit-I:

Basics of Estimation, Maximum Likelihood (ML), Application: Wireless Sensor Network, Reliability of Estimation, Wireless

Fading Channel Estimation, Cramer-Rao Bound for Estimation

Unit-II:
Vector Parameter Estimation, Properties of Estimate; Applications: Multi-antenna Wireless Channel Estimation, MIMO Wireless Channel Estimation, Error Covariance of Estimation, Equalization for Frequency Selective Channels

Unit-III:
OFDM Estimation, Sequential Estimation, Minimum Mean-Squared Error (MMSE) Estimate, Gaussian Parameter, Application: Wireless Sensor Network, Wireless Fading Channel Estimation

Unit-IV:
MMSE Estimation for Multi-Antenna Channel, MMSE for MIMO Channel Estimation, Properties of Estimate

Unit-V:
MMSE for Equalization of Wireless Channel, MMSE for OFDM Channel Estimation

Reference NPTEL MOOCs:
1. Principles of Signal Estimation for MIMO/OFDM Wireless Communications by Prof. Aditya K. Jagannatham

EC4402 ERROR CORRECTING CODES
Externals: 60Marks
(L-T)-P-C
Internals: 40Marks
4-0-3

Course Objectives:

- To study the importance of channel coding techniques in digital communications.
- To learn the mathematical structure of various codes
- To learn the algorithms for various codes
- To study the various application of codes.
- To acquire the knowledge of measurement of information
-

Course Outcomes:

3. At the end of this course Students will be able to
4. Understand principles of channel Coding techniques.
5. Analyze the performance of different codes.
6. Design various codes like block codes, cyclic codes, convolution codes, turbo codes etc.
7. Generate different codes.
8. Estimate the information content and errors

UNIT-I

Coding for Reliable Digital Transmission and Storage: Introduction, Types of codes, Types of errors, Channels models, Modulation and coding, channel coding Theorem, Channel coding gain.

UNIT-II

Linear Block codes: Introduction, encoding, syndrome decoding, error-detecting and correcting capabilities, Maximum likelihood decoding.Cyclic codes: Description, encoding and syndrome decoding.

UNIT- III

Galois Fields: Groups, Fields, Binary arithmetic, Construction of Galois Fields GF(2m), Basic properties of Galois Fields. RS codes: Introduction, encoding and decoding (Berlekamp-Massey algorithm).

UNIT- IV

Convolution codes: Introduction, Encoding, State diagram, Trellis diagram, Decoding - Maximum-Likelihood decoding, soft decision and hard decision decoding, Viterbi algorithm.

UNIT- V

Turbo codes: Concatenation, Types of Concatenation, interleaving, types of interleavers, Turbo codes: Introduction, encoding and decoding (BCJR Algorithm).

Text books:

Shulin and Daniel J. Costello, Jr. "Error Control Coding," 2/e, Pearson, 2011.

L.H.Charles LEE "Error control block codes for Communication Engineers", Artech, 2000.

Suggested readings:

Simon Haykin, "Communication Systems", 4/e, Wiley, 2000.

K Sam Shanmugum, "Digital and Analog Communication Systems", Wiley, 2005.

ECPE1_ INFORMATION THEORY AND CODING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless codingtheorem; Encoding of discrete sources.

Markov sources; Shannon's noisy coding theorem and converse for discrete channels;Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

Techniques of coding and decoding; Huffman codes and uniquely detectable codes;Cyclic codes, convolutional arithmetic codes.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand the concept of information and entropy

Understand Shannon's theorem for coding

Calculation of channel capacity

Apply coding techniques

Text/Reference Books:

N. Abramson, Information and Coding, McGraw Hill, 1963.

M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

R.B. Ash, Information Theory, Prentice Hall, 1970.

Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

EC4405 RADAR SYSTEMS
Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

6. To learn working principle of Radar Operating frequencies and derive Radar Range Equation,
7. To understand the basic concepts of different types of Radars for surveillance & Tracking.
8. To learn functioning of MTI radar and its performance limitations.
9. To get acquainted with the working principles of CW radar, FM-CW radar.
10. To understand concept of a Matched Filter in Radar Receivers gain knowledge of

different receiver blocks and understand receiver functioning

Course Outcomes:

7. At the end of this course Students will learn:
8. Distinguish between thefunctioning of CW FM-CW and MTI radars,
9. Apply Doppler principle to radars and hence detect moving targets.
10. Distinguish between Sequential Lobing, Conical Scan, Monopulse type 0f Tracking Radars, specify their requirements and compare their characteristic features.
11. Derive the matched filter response characteristics for radar applications and account for correlation receivers; to distinguish between different radar displays and duplexers.
12. Account for the electronic scanning principle and implement the same through phased array antennas, knowing their requirements and utilities.

UNIT-I: Basics of Radar

Introduction, Maximum Unambiguous Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Predictionof Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Related Problems. Radar Equation: SNR, Envelope Detector-False AlarmTime and Probability, Integration of Radar Pulses,Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Related Problems.

UNIT-II: CW and Frequency Modulated RadarDoppler Effect

CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Related Problems.FM-CW Radar: FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.

UNIT-III: MTI and Pulse Doppler Radar

Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar –Amplitude Comparison Monopulse (one- and two- coordinates), Angular Accuracy, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT-IV: Detection of Radar Signals in Noise

Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non- matched Filters, Matched Filter with Non-white Noise.

UNIT-V: Radar Receivers

Noise Figure and Noise Temperature, Displays – types, Introduction to Phased Array Antennas –Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Applications, Advantages and Limitations.ElectronicWarfare : Introduction to ESM, ECM and ECCM systems.

TEXT BOOKS:

1.Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2 nd

Edition, Tata McGraw-Hill, 2007.

REFERENCES:

1. Introduction to Radar Systems – Merrill I. Skolnik, 3 rd Edition Tata McGraw-Hill, 2001.

2. Radar: Principles, Technology, Applications-Byron Edde, Pearson Education, 2004.

3. Principles of Modern Radar: Basic Principles-Mark A. Richards, James A. Scheer, William

A. Holm, Yesdee,2013.

4. 'Radar Hand Book ' Ed. By M.I Skolnik, 2 nd Edition, Tata McGraw Hill.

5. 'Understanding Radar Systems' by Simon Kinsley and Shaun Quegan, Scitech Publishing,

McGraw-Hill.

EC4425 ADHOC WIRELESS SENSOR NETWORKS

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To introduction of fundamentals of Wireless LANS and PANS and its design issues.
- To understand the MAC protocols for Ad Hoc Wireless Networks and its designingissues.
- To introduction of different kinds of Routing algorithms for effective design of Ad HocWireless Networks.
- To introduction and designing issues in Transport Layer Protocol for Ad Hoc WirelessNetworks.
- Introduction of Wireless Sensor Networks and its Architecture.

Course Outcomes:

- At the end of this course Students will learn
- Students will be good at fundamentals of Wireless LANS and PANS and its designissues.
- Students will know the MAC protocols for Ad Hoc Wireless Networks and its
- designing issues.
- Student knows the different kinds of Routing algorithms for effective design of Ad
- Hoc Wireless Networks.

- Student will be ability to overcome the issues in Transport Layer Protocol for Ad Hoc
- Wireless Networks.
- Finally, student will be good at design and architecture of Wireless Sensor Networks.

UNIT -I:

Wireless LANS and PANS: Introduction, Fundamentals of WLANS, IEEE 802.11 Standards,HIPERLAN Standard, Bluetooth, Home RF.AD HOC Wireless Networks: Introduction, Issues in Ad Hoc Wireless Networks.

UNIT -II:

MAC Protocols: Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation

Mechanisms,Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocolsthat use Directional Antennas, Other MAC Protocols.

UNIT -III:

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc WirelessNetworks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – DemandRouting Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols.

UNIT –IV:

Transport Layer Protocols: Introduction, Issues in Designing a Transport Layer Protocol for AdHoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

UNIT –V:

Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

TEXT BOOKS:

Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI.

Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control – JagannathanSarangapani, CRC Press.

REFERENCES:

Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh , 1st Ed. Pearson Education.

Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer.

IoT and Applications

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

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ECPE1_ IoT Lab

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objective.

The course aims to introduce students to the concepts underlying the Internet of Things (IoT) through a series of lectures on the various topics that are important to understand the state-of-the-art as well as the trends for IoT. The students will be introduced to the history and evolution of IoT, as well as case studies from various industry domains. In addition, students will be required to work in teams to design, build, evaluate and test an innovative IoT system for a specific industry domain, such as sports and agriculture. Students will also be required to present their innovations to their peers in class as well as to the public (at the end of the course), and will also be required to document their findings in the form of a conference-style research paper. Students will also be exposed to real-world sports technologies, to witness these technologies in action behind-the-scenes, and to interact with experts from the industry.**

The lectures will be focused around industry domains (the verticals where IoT is applicable, or has been applied), platforms (the hardware or software platforms that are applicable for IoT), protocols (the communication protocols that are applicable to IoT) and services (the types of services that can layer over IoT).

TOPICS

Industry domains

IoT in Sports

IoT in Cities/Transportation

IoT in the Home

IoT in Retail

IoT in Healthcare

Platforms

Hardware, SoC, sensors, device drivers, IoT standards

Cloud computing for IoT

Bluetooth, Bluetooth Low Energy, beacons

Protocols

NFC, RFID, Zigbee

MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe

Wired vs. Wireless communication

GSM, CDMA, LTE, GPRS, small cell

Services/Attributes

Big-Data Analytics and Visualization

Dependability

Security

Maintainability

UNIT-I: Introduction & Concepts

Introduction & Concepts: Introduction to Internet of Things- Definitions & Characteristics of

IoT, Physical Design of IOT-Things in IoT, IoT Protocols, Logical Design of IOT-IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IOT Enabling Technologies- Wireless Sensor Networks, Cloud Computing, Big Data Analytics,Communication Protocols, Embedded Systems, IOT Levels & Deployment Templates.

UNIT-II: Domain Specific IoTs and M2M

IoT applications for Home Automation, Cities, Environment, Energy,Retail, Logistics,

Agriculture, Industry, health and Lifestyle

IoT and M2M – Introduction to M2M, Similarities and Differences between IoT and M2M.

UNIT-III: : IoT Platforms Design Methodology

Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process

Specification, Domain Model Specification, Information Model Specification, Service

Specifications, IoT Level Specification, Functional View Specification, Operational View

Specification, Device and Component Integration, Application Development, Case Study on IoT

System for Weather Monitoring.

UNIT-IV: Introduction to Python

Motivation for using Python for designing IoT systems, Language features of Python, Data

types- Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, Data Structures: Control of flow-if, for, while, range, break/continue, pass, functions, modules, packaging, file handling,

data/time operations, classes, Exception handling, Python packages of Interest for IoT - JSON,

XML, HTTPLib, URLLib, SMTPLib

UNIT-V: IoT Physical Devices and End Points

Basic building blocks of an IoT device, Rasberry Pi-About theRasberry Pi board, Rasberry Pi

interfaces-Serial, SPI,I2C, Interfacing an LED and switch with RPi and controlling.

Other IoT Devices- pcDuino, BeagleBone Black, CubieboardIoT

Course Outcome:

The Student is expected to design and develop an IoT real-world application in a specific domain arming with knowledge of Python and choosing hardware for specific application.

Textbook:

Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.

Referencens:

Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

Various research papers and articles recommended during course work.

EC4413
EMBEDDED SYSTEMS

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- Understand the basics of an embedded system.
- Program an embedded system.
- To learn the design process of embedded system applications.
- To understands the RTOS and inter-process communication.
- To understand different communication interfaces.

Course Outcomes:

- At the end of this course Students will learn:

- Understand and design the embedded systems
- Learn the basics of OS and RTOS.
- Understand types of memory and interfacing to external world.
- Understand embedded firmware design approaches.
- Understand the interfacing of communication devices.

UNIT-I: INTRODUCTION TO EMBEDDED SYSTEMS

Complex systems and microprocessors-embedding computers, characteristics of embedded computing applications, challenges in embedded computing system design, performance in embedded computing; The embedded system design process-requirements, specification, architecture design, designing hardware and software, components, system integration, design example.

UNIT-II: TYPICAL EMBEDDED SYSTEM

Core of the embedded system-general purpose and domain specific processors, ASICs, PLDs, COTs; Memory-ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems; Sensors, actuators and other components-sensors, actuators, seven segment LED, relay, piezo buzzer, push button switch, reset circuit, brownout protection circuit, oscillator circuit real time clock, watch dog timer.

UNIT-III: EMBEDDED FIRMWARE DESIGN AND DEVELOPMENT

Embedded firmware design approaches-super loop based approach, operating system based approach; Embedded firmware development languages-assembly language based development, high level language based development; Programming in embedded C.

UNIT-IV: RTOS BASED EMBEDDED SYSTEM DESIGN

Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling: non-preemptive and pre-emptive scheduling; task communication-shared memory, message passing.

UNIT-V: COMMUNICATION INTERFACE

Onboard communication interfaces-I2C, SPI, UART, 1 wire interface, parallel interface; External communication interfaces-RS232 and RS485,USB, infrared, Bluetooth, wi-Fi, zigbee, GPRS; Automotive networks and sensor networks.

TEXT BOOKS:

Computers as Components –Wayne Wolf, Morgan Kaufmann (second edition).

Introduction to Embedded Systems - shibu k v, Mc Graw Hill Education.

REFERENCES:

Embedded System Design -frank vahid, tony grivargis, john Wiley.

Embedded Systems- An integrated approach - Lyla b das, Pearson education 2012.

Embedded Systems – Raj kamal, TMH. 4. An embedded Software Primer, David e Simon, Pearson education

ECPE1_
NANO ELECTRONICS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Introduction to nanotechnology, meso structures,Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig-Penny Model. Brillouin Zones.

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets,

Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors,Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand various aspects of nano-technology and the processes involved in making nano components and material.

Leverage advantages of the nano-materials and appropriate use in solving practical problems.

Understand various aspects of nano-technology and theprocesses involved in making nano components and material.

Leverage advantages of the nano-materials and appropriate use in solving practical problems.

Text/ Reference Books:

G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.

W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.

K.E. Drexler, Nanosystems, Wiley, 1992.

J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

ECPE1_
INTRODUCTION TO MEMS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Introduction and Historical Background, Scaling Effects. Micro/Nano Sensors, Actuators and

Systems overview: Case studies. Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; Bulk

Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding. Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear

Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Course Outcomes:

At the end of the course the students will be able to

Appreciate the underlying working principles of MEMS and NEMS devices.

Design and model MEM devices.

Text/Reference Book:

G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.

S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).

S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.

M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.

G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.

M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

ECPE1_ MIXED SIGNAL DESIGN

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Analog and discrete-time signal processing, introduction to sampling theory;Analog continuoustime filters: passive and active filters; Basics of analog discrete-time filters and Z-transform.

Unit II:

Switched-capacitor filters- Nonidealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications.

Unit III:

Basics of data converters; Successive approximation ADCs, Dual slope ADCs,Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

Unit IV:

Mixed-signal layout, Interconnects and data transmission; Voltage-mode signalingand data transmission; Current-mode signaling and data transmission.

Unit V:

Introduction to frequency synthesizers and synchronization; Basics of PLL,Analog PLLs; Digital PLs; DLLs.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand the practical situations where mixed signal analysis is required.

Analyze and handle the inter-conversions between signals.

Design systems involving mixed signals

Text/Reference Books:

R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008.

Behzad Razavi , Design of analog CMOS integrated circuits, McGraw-Hill, 2003.

R. Jacob Baker, CMOS circuit design, layout and simulation, Revised second edition, IEEE press, 2008.

Rudy V. dePlassche, CMOS Integrated ADCs and DACs, Springer, Indian edition, 2005.

Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill, 1981.

R. Schauman, Design of analog filters by, Prentice-Hall 1990 (or newer additions).

M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford university press, first Indian edition, 2008.

ECPE1_ CMOS DESIGN

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor.Transistor as a switch. Inverter characteristics, Integrated Circuit Layout: Design Rules, Parasitics. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout. Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic. Sequential Circuit Design: Static circuits. Design of latches and Flip-flops.

Course Outcomes:

At the end of the course the students will be able to

Design different CMOS circuits using various logic families along with their circuit layout.

Use tools for VLSI IC design.

Text/Reference Books:

N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems

Perspective, 4thEdition, Pearson Education India, 2011.

C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.

J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.

P. Douglas, VHDL: programming by example, McGraw Hill, 2013.

L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

ECPE1_

POWER ELECTRONICS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Unit II:

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Unit III:

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper

Unit IV:

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter

Unit V:

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

Course Outcomes:

At the end of this course students will demonstrate the ability to

Build and test circuits using power devices such as SCR

Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,

Learn how to analyze these inverters and some basic applications.

Design SMPS.

Text /Reference Books:

Muhammad H. Rashid, "Power electronics" Prentice Hall of India.

Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.

P.C. Sen., "Modern Power Electronics", edition II, Chand& Co.

V.R.Moorthi, "Power Electronics", Oxford University Press.

Cyril W., Lander," Power Electronics", edition III, McGraw Hill.

G K Dubey, S R Doradla,: Thyristorised Power Controllers", New Age International Publishers. SCR manual from GE, USA.

ECPE1_ HIGH SPEED ELECTRONICS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency powerdelivery, methodologies for design of high speed buses; radiated emissions and minimizing system noise;

Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion,

Intermodulation,Cross-modulation, Dynamic range

Unit II:

Devices: Passive and active, Lumped passive devices (models), Active (models,low vs highfrequency)

Unit III:

RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages

Unit IV:

Mixers –Upconversion Downconversion, Conversion gain and spurious response.Oscillators Principles.PLL Transceiver architectures

Unit V:

Printed Circuit BoardAnatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand significance and the areas of application of high-speed electronics circuits.

Understand the properties of various components used in high speed electronics

Design High-speed electronic system using appropriate components.

Text/Reference Books:

Stephen H. Hall, Garrett W. Hall, James A. McCall “High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices”, August 2000, Wiley-IEEE Press

Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, CambridgeUniversity Press, 2004, ISBN 0521835399.

Behzad Razavi, “RF Microelectronics”, Prentice-Hall 1998, ISBN 0-13-887571-5.

Guillermo Gonzalez, “Microwave Transistor Amplifiers”, 2nd Edition, Prentice Hall.

Kai Chang, “RF and Microwave Wireless systems”, Wiley.

R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

ECPE1_ EMBEDDED SYSTEMS DESIGN

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Prerequisite: Microprocessor and Microcontrollers Course

Objectives:

1. To provide an overview of Design Principles of Embedded System.

2. To provide clear understanding about the role of firmware , operating systems in correlation with hardware systems.

Course Outcomes:

1. Expected to understand the selection procedure of Processors in the Embedded domain.

2. Design Procedure for Embedded Firmware.

3. Expected to visualize the role of Real time Operating Systems in Embedded Systems

4. Expected to evaluate the Correlation between task synchronization and latency issues

UNIT -I:

Introduction to Embedded Systems Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT -II:

Typical Embedded System: Core of the Embedded System: General Purpose and

Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT -III:

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT -IV:

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT -V:

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

TEXT BOOKS:

Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

REFERENCE BOOKS:

Embedded Systems - Raj Kamal, TMH.

Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.

Embedded Systems – Lyla, Pearson, 2013

An Embedded Software Primer - David E. Simon, Pearson Education.

EC4421 ANALOG VLSI AND MIXED SIGNAL DESIGN

Externals: 60Marks

(L-T)-P-C

Internals: 40Marks

4-0-3

Course Objective:

- To understand the types of active filters and its operation.
- To understand the types of continuous time filters and digital filters and its operation.
- To understand various ADC and DAC converters and its importance in the Electronic systems.
- Gives Knowledge on VHDL Programming language for Mixed Signal Circuit Design.
- Extension the Verilog concepts for analog VLSI circuits.

Course Outcomes:

- Able to design filters with active devices only.
- Able to design the first and second order digital filters.
- The ability to use and design DAC and ADC techniques for data conversions.
- The ability to program, Mixed Signal VLSI Circuits.
- Verilog program for analog VLSI circuits.

UNIT I: Introduction to Active Filters (PLL) & Switched capacitor filters

Active RC Filters for monolithic filer design: First & Second order filter realizations - universal active filter (KHN)-self tuned filter - programmable filters - Switched capacitor filters: Switchedcapacitor resistors - amplifiers –comparators - sample & hold circuits – Integrator- Biquad.

UNIT II: Continuous Time filters & Digital Filters

Introduction to Gm - C filters - bipolar transconductors - CMOS Transconductors using Triode transistors, active transistors - BiCMOStransconductors – MOSFET C Filters - Tuning Circuitry - Dynamic range performance -Digital Filters: Sampling – decimation – interpolation - implementation of FIR and IIR filters.

UNIT III: Digital to Analog & Analog to Digital Converters

Non-idealities in the DAC - Types of DAC’s: Current switched, Resistive, Charge redistribution (capacitive), Hybrid, segmented DAC’s - Techniques for improving linearity - Analog to Digital Converters: quantization errors -non-idealities - types of ADC’s: Flash, two step, pipelined, successive approximation, folding ADC’s.Sigma Delta Converters: Over sampled converters - over sampling without noise & with noise – implementation imperfections - first order modulator - decimation filters- second order modulator - sigma delta DAC & ADC’s

UNIT IV: Analog and Mixed Signal Extensions to VHDL

Introduction - Language design objectives - Theory of differential algebraic equations - the 1076 .1 Language - Tolerance groups - Conservative systems - Time and the simulation cycle -A/D and D/A Interaction - Quiescent Point - Frequency domain modeling and examples.

UNIT V: Analog Extensions to Verilog

Introduction –data types – Expressions-Signals-Analog Behavior-Hierarchical structures-Mixed Signal Interaction. Introduction - Equation construction - solution - waveform Filter functions - simulator - Control Analysis - Multi -disciplinary model.

TEXT BOOKS:

David A. Johns, Ken Martin, "Analog Integrated Circuit Design" John Wiley & Sons, 2002.

Rudy van de Plassche "Integrated Analog-to-Digital and Digital-to-Analog Converters ",Kluwer 1999.

Antoniou, "Digital Filters Analysis and Design" Tata McGraw Hill, 1998.

REFERENCES:

Phillip Allen and Douglas Holmberg "CMOS Analog Circuit Design" Oxford University. Press, 2000.

BenhardRazavi, "Data Converters", Kluwer Publishers, 1999.

Jacob Baker, Harry W LI, and David E Boyce "CMOS, Circuit Design Layout and Simulation", Wiley- IEEE Press, 1 st Edition, 1997.

Tsividis Y P, "Mixed Analog and Digital VLSI Devices and Technology", Mc-Graw Hill,1996.

ECPE1_ CMOS ANALOG VLSI DESIGN

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

COURSE OBJECTIVES

1. To understand CMOS analog circuits design
2. To simulate Analog circuits using H SPICE.
3. To learn noise modeling of CMOS analog circuits

UNIT I - ANALOG CMOS SUB-CIRCUITS

Introduction to analog design, Passive and active current mirrors, band-gap references, Switched
Capacitor circuits - basic principles, sampling switches, switched capacitor integrator, switched
capacitor amplifier, simulation of CMOS sub circuits using SPICE.

UNIT II - CMOS SINGLE STAGE AMPLIFIERS

Common-Source stage (with resistive load, diode connected load, current-source load, triode load, source degeneration), source follower, common-gate stage, cascode stage, folded cascode stage. Frequency responses of CS stage, CD stage, CG stage, cascode stage, simulation of CMOS amplifiers using SPICE.

UNIT III - DIFFERENTIAL AMPLIFIER & OPERATIONAL AMPLIFIERS

Single-ended and differential operation, basic differential pair – qualitative and quantitative analyses, common-mode response, differential pair with MOS loads, Performance parameters of op-amp, one stage op-amp, two-stage CMOS op-amp, Gain boosting, slew rate, power supply rejection, Simulation of differential amplifiers using SPICE.

UNIT IV - OSCILLATORS

General considerations, Ring oscillators, LC oscillators – cross-coupled oscillators, Colpitts oscillator, One-port oscillator, and voltage controlled oscillators. Simulation of oscillators using SPICE.

UNIT V - NOISE CHARACTERISTICS

Statistical characteristics of noise, Types of noise - thermal noise, flicker noise, Representation of noise in circuits, noise in single-stage amplifiers (CS, CD and CG stages), noise bandwidth.

TEXT BOOK

Razavi, *"Design of analog CMOS integrated circuits",* McGraw Hill, Edition 2002.

REFERENCES

1. Gray, Meyer, Lewis, Hurst, *"Analysis and design of Analog Integrated Circuits",* Willey International, 4th Edition, 2002.
2. Allen, Holberg, *"CMOS analog circuit design",* Oxford University Press, 2nd Edition, 2012.

COURSE OUTCOMES

1. Analog circuits are essential in interfacing and building amplifiers and low pass filters.
2. Able to do the design of analog sublevel blocks.
3. Learn some design methods for CMOS analog circuit.

ECPE1 CMOS DIGITAL VLSI DESIGN

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

1. This is an introductory course which covers basic theories and techniques of digital VLSI Circuit design in CMOS technology.

2. In this course, we will study the fundamental concepts and structures of MOS Transistor and designing digital VLSI Circuits, static and dynamic Power Dissipation, interconnect analysis, Propagation delays, MOS Inverters and their Characteristics.

3. The course is designed to give the student an understanding of the different Combinational circuit design, Sequential MOS Logic Gates and CMOS Dynamic Logic Circuits including their Transient Analysis, design steps and behavior.

Unit I MOS Transistor-First Glance at the MOS device, MOS Transistor under static conditions, threshold voltage, Resistive operation, saturation region, channel length modulation, velocity saturation, Hot carrier effect-drain current Vs voltage charts, sub threshold conduction, equivalent resistance, MOS structure capacitance & CMOS logics.

Unit II MOS Inverter, Switching characteristics & Interconnect Effects- Delay Time, Interconnect Parasitic Capacitances, Resistance, RC Delays, Inductances, Gate Delays, Stage Ratio, Power Dissipation, CMOS Logic Gate Design, Transmission Gate & BiCMOS.

Unit III Combinational Circuit Design: NAND Gate, NOR Gate, Transient Analysis of NAND & NOR Gate. Sequential MOS Logic Gates: Behavior of Bitable element, CMOS latches & Clocked Flip-Flops, Clock Skew & Clocking Strategies.

Unit IV CMOS Dynamic Logic Circuits: Pass Transistor Logic-0 and 1 transfer, Charge Storage & Leakage. Voltage Bootstrapping. High Performance Dynamic CMOS Circuits: Domino CMOS Logic. NORA CMOS Logic, Zipper CMOS Circuits, TSPC Dynamic CMOS.

Unit V Semiconductor Memories: ROM, DRAM, SRAM, PLA, Cell, Leakage Circuit and Input/output Circuit.

Text books:

1.Jan.M.Rabaey., Anitha Chandrakasan Borivoje Nikolic, "Digital Integrated Circuits", SecondEdition.

2.Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital IC- Analysis and Design", 3rd Edition, Tata McGraw Hill.

Reference books:

1.Neil H.E Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", 2nd Edition, Addition Wesley, 1998.

COURSE OUTCOMES

1. Able to design digital circuits in circuit-level.

2. Able to have a digital circuit design with optimizing speed and area.

3. Semiconductor memories cell can be enhanced with the existed memory cells.

EC4411 REAL TIME OPERATING SYSTEMS
Externals: 60Marks (L-T)-P-C

Internals: 40Marks 4-0-3

Course Objectives:

7. To understand the need of real time operating system.
8. To learn the basic concepts of inter process communication (IPC).
9. To analyze various scheduling algorithms related to RTOS.
10. To introduce the elementary concepts of Vx works.
11. To study the basic concepts of UNIX operating system.

Course Outcomes:

- At the end of this course Students will learn:
- 1.Understand Real-time operating system requirements and applications.
- Categorize different scheduling approaches for real time scheduler.
- Compare different real time systems.
- Analyze a module and understand design issues.
- Develop a real time embedded system module.

UNIT-I:

Introduction to Real Time Systems Structures of Operating System (Monolithic, Microkernel, Layered, Exo-kernel and Hybrid kernel structures), Operating system objectives and functions, Virtual Computers, Interaction of OS and Hardware architecture, Evolution of operating systems, Batch, multi programming. Multitasking, Multiuser, parallel, distributed and real-time OS.

UNIT-II:

Process Management of OS/RTOS Hard versus Soft Real-Time System: Jobs and Processors, release time, deadlines, and timing constraints, hard and soft timing constraints, hard real-time systems. Uniprocessor Scheduling: Types of scheduling, scheduling algorithms: FCFS, SJF, Priority, Round Robin, UNIX Multi-level feedback queue scheduling, Thread scheduling, Multiprocessor scheduling concept, Real Time scheduling concept.

UNIT-III:

Real Time Operating System Concepts Foreground and Background Systems, Shared Resource, Critical section of a Code, Multi-Tasking, Task, Context switch, Kernel, Scheduler, Preemptive and non-preemptive kernel, Inter Task Communication: Message Mailboxes, Message queues or pipes and Event flags, Semaphores, Interrupts

UNIT-IV:

Introduction to Vx works/UNIX OS Elementary Concepts of Vx Works: Multitasking, Task State Transition, Task Control- Task Creation and Activation, Task Stack, Task Names and IDs, Task Options, Task Information, Task Deletion and Deletion Safety. Fundamental Concepts of UNIX Operating Systems UNIX Kernel – File system, Concepts of – Process, Concurrent Execution & Interrupts. Process Management – forks & execution. Basic level Programming with system calls, Shell programming and filters.

UNIT-V:

Linux development process Types of Host /Target Development and debug setup, Generic Architecture of an Embedded Linux System, System start up, Types of Boot configurations, System Memory Layout, Development Tools: Project Workspace, IDE, GNCC cross platform, selecting and configuring kernel, setting up boot loader.

TEXT BOOKS:

Tanenbaum,"Modern Operating Systems," 4/e, Pearson Edition, 2014.

Jane W.S.Liu, Real Time Systems, Pearson Education, Asia, 2001. REFERENCES: 1. Jean J Labrosse,"Embedded Systems Building Blocks Complete and Ready-to-use Modules in C" ,2/e, CRC Press ,1999. 2. Karim Yaghmour, Jon Masters, Gilad Ben-Yesset, Philippe Gerum, "Building Embedded Linux Systems", O'Reilly Media, 2008.

Wind River Systems, "VxWorks Programmers Guide 5.5", Wind River Systems Inc.2002.

Course Outcomes:

- Understands the complete VLSI CAD tool flow.
- Able to follow the design rules and debug it while creating layouts for circuits in VLSI CAD tool and also understands the placement and partitioning of the digital systems.
- Able to debug the floor planning and routing problems in the VLSI CAD tools for the digital systems.
- Understands the simulation and synthesis process and make advantage to debug the errors when developing and using the VLSI CAD tools.
- Able to develop a synthesis process in the VLSI CAD tools

EC4423 CAD FOR VLSI CIRCUITS
Externals: 60Marks **(L-T)-P-C**
Internals: 40Marks **4-0-3**

Course Objectives:

- To make understand the VLSI CAD tools flow with Algorithmic Graphs.
- Gives knowledge on layout design rules and various algorithms for placement and partitioning of circuits.
- Understands the Floor planning and routing process in the VLSI CAD tools.
- Knows the various concepts of simulation and synthesis process in VLSI CAD tools.
- Gives Knowledge on modelling concepts of synthesis process.

UNIT I: VLSI DESIGN METHODOLOGIES

Introduction to VLSI Design methodologies - Review of Data structures and algorithms - Review of VLSI Design automation tools - Algorithmic Graph Theory and Computational Complexity - Tractable and Intractable problems - general purpose methods for combinatorial optimization.

UNIT II:DESIGN RULES

Layout Compaction - Design rules - problem formulation - algorithms for constraint graph compaction - placement and partitioning - Circuit representation - Placement algorithms - partitioning

UNIT III:FLOOR PLANNING

Floor planning concepts - shape functions and floorplan sizing - Types of local routing problems - Area routing - channel routing - global routing - algorithms for global routing.

UNIT IV:SIMULATION

Simulation - Gate-level modeling and simulation - Switch-level modeling and simulation - Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis.

UNIT V:MODELLING AND SYNTHESIS

High level Synthesis - Hardware models - Internal representation - Allocation assignment and scheduling - Simple scheduling algorithm - Assignment problem - High level transformations.

TEXTBOOKS:

S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.

N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.

EC4424 RF INTEGRATED CIRCUITS

Externals: 60Marks (L-T)-P-C

Internals: 40Marks 4-0-3

Course Objectives:

- To educate students fundamental RF circuit and system design skills.
- To introduce students, the basic transmission line theory, single and multiport networks, RF component modelling.
- To offer students experience on designing matching and biasing networks & RF transistor amplifier design.

Course Outcomes:

- At the end of this course Students will learn:
- Understand the design bottlenecks specific to RF IC design, linearity related issues, ISI.
- Identify noise sources, develop noise models for the devices and systems.
- Specify noise and interference performance metrics like noise figure, IIP3 and different matching criteria.
- Comprehend different multiple access techniques, wireless standards and various transceiver architectures
- Design various constituents' blocks of RF receiver front end.

Unit I: INTRODUCTION TO RF AND WIRELESS TECHNOLOGY:

Complexity comparison, Design bottle necks, Applications, Analog and digital systems, Choice of Technology. BASIC CONCEPTS IN RF DESIGN: Nonlinearity and time variance, ISI, Random process and noise, sensitivity and dynamic range, passive impedance transformation.

Unit II: MULTIPLE ACCESS:

Techniques and wireless standards, mobile RF communication, FDMA, TDMA, CDMA, Wireless standards.

Unit III: TRANSCEIVER ARCHITECTURES:

General considerations, receiver architecture, Transmitter Architecture, transceiver performance tests, case studies.

Unit IV: AMPLIFIERS, MIXERS AND OSCILLATORS:

LNAs, down conversion mixers, Cascaded Stages, oscillators, Frequency synthesizers.

Unit V: POWER AMPLIFIERS:

General considerations, linear and nonlinear Pas, classification, High Frequency power amplifier, large signal impedance matching, linearization techniques.

Text Books:

BehzadRazavi, RF Microelectronics Prentice Hall of India, 2001

Thomas H. Lee, the Design of CMOS Radio Integrated Circuits, Cambridge University Press.

ECPE1_ FIBER OPTIC COMMUNICATION

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Introduction to vector nature of light, propagation of light, propagation of light ina cylindrical dielectric rod, Ray model, wave model.

Unit II:

Different types of optical fibers, Modal analysis of a step index fiber.

Signaldegradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

Unit III:

Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detectorresponsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

Unit IV:

Optical switches - coupled mode analysis of directional couplers, electro-opticswitches.

Optical amplifiers - EDFA, Raman amplifier.

Unit V:

WDM and DWDM systems. Principles of WDM networks.

Nonlinear effects in fiber optic links. Concept of self-phase modulation, groupvelocity dispersion and solition based communication.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand the principles fiber-optic communication, the components and the bandwidth advantages.

Understand the properties of the optical fibers and optical components.

Understand operation of lasers, LEDs, and detectors

Analyze system performance of optical communication systems

Design optical networks and understand non-linear effects in optical fibers

EC4434 ANTENNAS AND WAVE PROPAGATION

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- Understand basic terminology and concepts of Antennas.
- To attain knowledge on the basic parameters those are considered in the antenna design process and the analysis while designing that.
- Analyze the electric and magnetic field emission from various basic antennas and
- mathematical Formulation of the analysis.
- To have knowledge on antenna operation and types as well as their usage in real time filed.
- Aware of the wave spectrum and respective band based antenna usage and also to know thepropagation of the waves at different frequencies through different layers in the existing layered free space environment structure.

Course Outcomes:

- Student will be able to:
- Aware of antenna parameter considerations
- Capable to analyze the designed antenna and field evaluation under various conditions andformulate the electric as well as magnetic fields equation set for far field and near field conditions
- Understand the array system of different antennas and field analysis under application of different currents to the individual antenna elements
- Understand the design issues, operation of fundamental antennas and their operation
- methodology in practice.
- Design a lens structure and also the bench set up for antenna parameter measurement of testingfor their effectiveness
- Knowledge about the means of propagation of electromagnetic waves

UNIT-I: Antenna Basics:

Introduction, Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Illustrative Problems. Fields fromOscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation, Retarded Potentials – Helmholtz Theorem.Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area, Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths, Illustrative Problems. Loop Antennas - Introduction, Small Loop, Comparison of Far Fields of Small Loop and Short Dipole, Radiation Resistances.

UNIT-II: Antenna Arrays:

Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, Endfire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays, Illustrative Problems.

Antenna Measurements:Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3- Antenna Methods)

UNIT-III: VHF, UHF and Microwave Antennas-I:

Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics,Helical Antennas – Helical Geometry, Helix Modes, Practical Design Considerations for Monofilar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types, Optimum Horns, Design Considerations of Pyramidal Horns, Illustrative Problems.

VHF, UHF and Microwave Antennas - II:

Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas– Geometry and Parameters, Characteristics of Microstrip Antennas. Impact of Different Parameters on Characteristics, 103 Reflector Antennas – Introduction, Flar Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features, Illustrative Problems. Lens Antennas – Introduction, Geometry of Non-metallic Dielectric Lenses, Fermat‘s Principle, Zoning, Applications.

UNIT-IV: Wave Propagation – I:

Introduction, Definitions, Categorizations and General Classifications, Different Modes of WavePropagation, Ray/Mode Concepts, Ground Wave Propagation (Qualitative Treatment) Introduction, Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections. Space Wave Propagation – Introduction, Field Strength Variation with Distance andHeight, Effect of Earth‘s Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering Phenomena, Tropospheric Propagation.

UNIT-V: Wave Propagation – II:

Sky Wave Propagation – Introduction, Structure of Ionosphere, Refraction and Reflectionof Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multihop Propagation.

TEXT BOOKS:

Antennas and Wave Propagation – J.D. Kraus, R.J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 4thed., (Special Indian Edition), 2010.

Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd ed.2000.

A.Harish, M.Sachidanada," Antennas and Wave Propagation", Oxford University Press,2007

REFERENCES:

Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.

Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications,New Delhi,2001.

Transmission and Propagation – E.V.D. Glazier and H.R.L. Lamont, The Services Text Book of Radio,vol. 5, Standard Publishers Distributors, Delhi.

Antennas – John D. Kraus, McGraw-Hill (International Edition), 2nd Ed. 1988.

Electronic and Radio Engineering – F.E. Terman, McGraw-Hill, 4th edition, 1955.

ECPE1_ MICROWAVE THEORY AND TECHNIQUES

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

Unit II:

Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line. Microwave Network Analysis-Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters.

Unit III:

Passive and Active Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

Unit IV:

Microwave Design Principles- Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas- Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas. Microwave Measurements- Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of Microwave antenna parameters.

Unit V:

Microwave Systems- Radar, Terrestrial and Satellite Communication, Radio Aidsto Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand various microwave system components their properties.

Appreciate that during analysis/ synthesis of microwave systems, the different mathematical treatment is required compared to general circuit analysis.

Design microwave systems for different practical application.

Text/Reference Books:

R.E. Collins, Microwave Circuits, McGraw Hill

K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

EC4426 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

This course provides

- An introduction to measurement techniques and instrumentation design and operation
- The basic concepts of units measurement error and accuracy, the construction and design of measuring devices and circuits measuring instruments and their proper applications
- To use different measuring techniques and measurement of different physical parameters using different transducers

Course Outcomes:

- Upon a successful completion of this course, the student will be able to:
- Describe the fundamental concepts and principles of instrumentation.
- Explain the operations of the various instruments required in measurements.
- Apply the measurement techniques for different types of tests.
- To select specific instrument for specific measurement function.
- Understand principle of operation, working of different electronic instruments like digital multi meter, vector voltmeter.
- Learners will apply knowledge of different oscilloscopes like CRO, DSO.
- Students will understand functioning, specification, and applications of signal analyzing instruments.

UNIT - I:

Block Schemantics of Measuring Systems: Performance characteristics, Static characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag; Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

UNIT - II:

Signal Analyzers: AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary waveform Generator, Video Signal Generators, and Specifications.

UNIT - III:

Oscilloscopes: CRT, Block Schemantic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Strorage Oscilloscopes, Digital Storage CROs.

UNIT - IV:

Transuducers: Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperatue sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

UNIT - V:

Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

Measurement of Physical Parameters: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure - High Pressure, Vacuum level, Temperature - Measurements, Data Acqisition Systems.

TEXTBOOKS:

Electronic instrumentation: H.S.Kalsi - TMH, 2nd Edition 2004.

Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI, 5th Edition, 2003.

REFERENCES:

Electronic Instrumentation and Measurements - David A. Bell, Oxford Uiv. Press, 1997.

Electronic Measurements and Instrumentation: B. M. Oliver, J. M. Cage TMH Reprint.

Measurement Systems - Emest O. Doebelin and Dhanesh N Manik, 6th Ed., TMH.

Electronic Measurements and Instrumentations by K. Lal Kishore, Pearson Education - 2010.

Industrial Instrumentation: T. R. Padmanabham Spiriger 2009.

SCHEME OF EVALUATION

Special Evaluation Pattern for the following courses:

S.NO.	Type of Course	Internals	Externals
1	HS1101: Communication Skills-I, HS1201: Communication Skills-II (Theory course)	Activities and Assignments = 40Marks	Written exam: 60Marks
2	HS1601: English Language Lab	Orals (50Marks)	Written exam: 50Marks
3	CE1001 (Engineering Graphics): (Course Type: Lab)	40	60

SCHEME OF EVALUATI

Assessment Method		Description
Assignment & Continuous monitoring		Assignments drawings
Mid Term		2 mid ex conducted a considered.
End Term		Students wi on the ur principles, s the course

6	19ECP03(3 credits Project),19ECP04(8 credits project)	Three Internal Rev 60Marks
7	19ECCV-I,19ECCV-II (0 credit Comprehensive Viva)	NA

Evaluation Pattern for General Courses:

S.NO.	**Type of Course**	**Internals**	**Externals**
1	Theory	Best two out of Three MTs (2x15) + Assignments (10)= 40Marks	60Marks
2	Lab	(Report+Record) (20)+ Attendance(10) + Internal Viva (10)= 40 Marks	Lab Experiment (40) + External Viva (20) = 60 Marks
3	19EC2901,19EC2902, 19EC3901 (1 credit Mini project, 1 credit Technical seminar)	NA	100Marks
4	19ECP01 (2 credits Mini project)	Mid-Sem review (40 Marks)	End-Sem review (60 Marks)
5	19ECP02 (1 credit Summer Internship)	Industry Expert (30 Marks) + RGUKT panel (70 Marks)	

Rajiv Gandhi University of Knowledge and Technology
Basar, Mudhole, Adilabad – 504107
B. TECH. ELECTRONICS AND COMMUNICATION ENGINEERING

Regulations -2019

B17 Batch Course Structure for B.Tech

Electronics and Communications Engineering (RGUKT-Basar)

I SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	MA1101	Linear Algebra	BSC	3	0	0	3	3
2	MA1102	Calculus	BSC	2	0	0	2	2
3	EC1101	Digital Electronic Circuits	PCC	3	0	0	3	3
4	EC1701	Digital Electronic Circuits Lab	BSC	0	0	3	3	1.5
5	ME1102	Engineering workshop	ESC	2	0	2	4	3
7	HS1101	Communication Skills-I	HSMC	2	0	0	2	0
8	CS1101	Programming for Problem Solving	ESC	3	0	0	3	3
9	CS1701	Programming for Problem Solving Lab	ESC	0	0	4	4	2
Total				15	0	9	24	17.5
Induction Program (Non-credit)- Syllabus as per AICTE guide lines								

II SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EE1203	Basic Electrical Engineering	ESC	4	0	0	4	4
2	EE1803	Basic Electrical Engineering lab	ESC	0	0	3	3	1.5
3	MA1201	Differential equations and Vector Calculus	BSC	3	1	0	4	4
4	PH1202	Physics	BSC	3	1	0	4	4
5	PH1802	Physics Lab	BSC	0	0	3	3	1.5
6	CE1801	Engineering Graphics	ESC	1	0	4	5	3
7	HS1201	English	HSMC	2	0	0	2	2
8	HS1801	English Language Lab	HSMC	0	0	2	2	1
9	HS1202	Communication Skills – II	HSMC	2	0	0	2	0

Total			15	3	12	30	21

III SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	CY2102	Chemistry	BSC	3	0	0	3	3
2	CY2701	Chemistry Lab	BSC	0	0	2	2	1
3	EC2102	Electronic Devices and Circuits	PCC	3	1	0	4	4
4	EC2702	Electronic Devices and Circuits lab	PCC	0	0	3	3	1.5
5	EC2103	Signals and Systems	PCC	3	1	0	4	4
6	EC2901	Electronics mini Project-I	PJT	0	0	2	2	1
7	MA2104	Transform Calculus and Complex Analysis	BSC	3	1	0	4	4
8	HS2101	Essence of Indian Traditional Knowledge	MC	2	0	0	2	0
9	BS2101	Environmental Science	MC	2	0	0	2	0
Total				16	3	7	26	18.5

IV SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EC2201	Analog Circuits	PCC	3	0	0	3	3
2	EC2801	Analog Circuits lab	PCC	0	0	2	2	1
3	EC2202	Control systems	PCC	3	0	0	3	3
4	EC2203	Electromagnetic Waves	PCC	3	0	0	3	3
5	EC2204	Probability Theory and Stochastic Processes	PCC	3	1	0	4	4
6	CS2205	Object Oriented Programming	ESC	3	0	0	3	3
7	CS2804	Object Oriented Programming lab	ESC	0	0	2	2	1
8	EC2902	Electronics mini Project-II	PJT	0	0	2	2	1
9	BM0007	Managerial Economics and Financial analysis	HSMC	3	0	0	3	3
10	BM0005	Constitution of India	MC	2	0	0	2	0

Total		20	1	6	27	22

V SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EC3101	Analog and Digital Communications	PCC	3	0	0	3	3
2	EC3701	Analog and Digital Communications lab	PCC	0	0	2	2	1
3	EC3102	Computer Architecture	PCC	3	0	0	3	3
4	EC3103	Digital Signal Processing	PCC	3	0	0	3	3
5	EC3702	Digital Signal Processing lab	PCC	0	0	2	2	1
6	EC3104	RF and Microwave Engineering	PCC	3	0	0	3	3
7	EC3703	RF and Microwave Eng. Lab	PCC	0	0	2	2	1
8	EC3105	VLSI Engineering	PCC	3	0	0	3	3
9		Open Elective-1		3	0	0	3	3
10	EC3901	Technical Seminar (on recent trends)	PJT	0	0	2	2	1
Total				18	0	8	26	22

VI SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EC3201	Micro-Controllers and Interfacing	PCC	3	0	0	3	3
2	EC3801	Micro-Controllers lab	PCC	0	0	2	2	1
3	EC3202	Digital System Design	PEC	3	0	0	3	3
4	EC3802	Digital Systems Design and VLSI Lab	PCC	0	0	2	2	1
5	EC_	Pattern Recognition	PEC	3	0	0	3	3
6	CS3203	Operating Systems	ESC	3	0	0	3	3
7	BM0003	Operations Research (Management Dept)	HSMC	3	0	0	3	3
8	ECP01	Mini Project	PJT	0	0	4	4	2

9	ECCV-I	Comprehensive Viva-I						0
10	ECP02	Summer Internship						1
Total				15	0	8	23	20

VII SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EC_	Signal Processing stream elective	PEC	3	0	0	3	3
2	EC_	Communications stream elective	PEC	3	0	0	3	3
3	EC_	Embedded systems stream elective	PEC	3	0	0	3	3
4	ECP03	Project Stage-I	PJT	0	0	6	6	3
5	BM0010	Professional Law and Ethics	HSMC	3	0	0	3	3
6	CS4101	Computer Networks	ESC	3	0	0	3	3
7	CS4701	Computer Networks lab	ESC	0	0	2	2	1
Total				15	0	8	23	19

VIII SEMESTER

Sl. No.	Course Code	Course Title	Course Category	Hours per week			Total contact hours	Credits
				L	T	P		
1	EC_	Program Elective-4 (Preferably course on Antennas)	PEC	3	0	0	3	3
2	EC_	Open Elective-3	PEC	3	0	0	3	3
3		Open Elective-4		3	0	0	3	3
4		Open Elective-5		3	0	0	3	3
5	ECP04	Project Stage-II	PJT				16	8
6	ECCV-II	Comprehensive viva-II						0

Total				12	0	16	28	20

B17 Batch Course Curriculum for B.Tech
Electronics and Communications Engineering (RGUKT-Basar)

I SEMESTER

MA1101 **LINER ALGEBRA**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives: To learn

- Concept of vector spaces and Linear Transformation
- Types of matrices and their properties.
- Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- Concept of Eigen values and Eigen vectors and to reduce the quadratic form to canonical form.
- Concept of Singular value decomposition
- Matrix factorization (QR,LU,LDU).

Course Outcomes:

- Write the matrix representation of set of linear equations and to analyze the solution of the system of equations.
- Find the Eigen values and Eigen vectors of a matrix
- Reduce the quadratic form to canonical form using orthogonal transformations.
- Write the Jordon canonical forms of a matrix
- Find the factorization of Matrices(LU,QR,LDU).

Unit-I

Vector spaces:

Vector Space, subspace, span of vectors ,linear dependence of vectors, basis, dimension; Linear transformations (maps),range and kernel of a linear map, rank and nullity, Inverse of a linear transformation, rank-nullity theorem, Matrix associated with a linear map.

Unit-II

Algebra of matrices, four ways of multiplying matrices, Hermition and unitary matrices, Left inverse and right inverse of a matrix, Four subspaces associated with a matrix, Dimensions of four subspaces of matrix, Fundamental theorem of linear Algebra

Null space of a matrix, Row reduced echelon form of a matrix, rank of a matrix elementary matrices, permutation matrices, Solvability of system $AX = b$, consistency of solutions, Complete solution of $Ax = b$,

UNIT-III

Inner product on a vector space, norm of a vector, Angle between the vectors, Orthogonal vectors, Orthogonal subspaces, Fundamental theorem of Orthogonality, Orthogonal complement of a subspace, projection of a vector over a vector and subspace, Projection matrix and Least square fitting of data.

Unit-IV

Orthogonal bases of a vector space, Gram Schmidt method, QR factorization of a matrix.

Eigen values and Eigen vectors of a matrix, special case to Hermition and unitary matrices, Cayley -Hamilton Theorem (Without proof),finding inverse and power of a matrix by Cayley-Hamilton Theorem,Diagonalization of matrix.

UNIT-V

Similar matrices, Jordon canonical form of a matrix, Quadratic forms and Nature of the Quadratic forms, Positive definite and semi positive definite forms, Reduction of quadratic form to canonical form by Orthogonal transformation. Singular value Decomposition of a matrix

Text Books:

- Introduction to Linear Algebra by Gilbert Strang
- Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8^{th} Edition,

Reference Books:

- Linear algebra by Kenneth Hoffmann and Ray Kunze.
- R.K.Jain and S.R.K.Iyengar Advanced Engineering Mathematics, Narosa Publications House.2008

MA1102 **CALCULUS**

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **2-0-0-2**

Course Objectives: To learn

- Concept of Sequence.
- Concept of nature of series.
- Geometrical approach to the mean values theorems and their application to the mathematical problems.
- Evaluation of surface areas and volumes of revolutions of curves.
- Evaluation of improper integrals using Beta and Gamma functions.
- Partial differentiation, concept of total derivative.
- Finding maxima and minima of function of two and three variables.

Course outcomes: After learning the concepts of this paper the student must be able to .

- Analyze the nature of sequence and series.
- Solve the applications on the mean value theorems.
- Evaluate the improper integrals using Beta and Gamma functions.
- Find the extreme values of functions of two variables with/without constraints.

UNIT-I

Sequences

Definition of a sequence, limit; Convergent, Divergent and Oscillatory sequences. Sandwich theorem,Tests for discussing the convergence and divergence of the sequence

Unit-II

Series

Definition of Series, Convergent, Divergent and Oscillatory Series; Series of positive terms;

Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test; Logarithmic test. Alternating series; Leibnitz test; Alternating Convergent series; Absolute and conditionally convergence of a series

UNIT-III

Mean Value Theorems and Taylor series

Mean value theorems: Roll's theorem, Lagrange's Mean value theorem, Cauchy's Mean value theorem; Taylor's and Macaurin's series with remainders, Expansions;

UNIT-IV

Applications of Definite Integrals and Improper Integrals

Applications of definite integrals to evaluate surface area and volumes of revolutions of curves (Only in Cartesian coordinates)Definition of Improper Integrals and their convergence, Beta and Gamma functions and their applications.

UNIT-V

Multivariable Calculus (Partial Differentiation and applications):

Definitions of Limits and continuity. Partial Differentiation; Euler's theorem; Total Derivative; Jacobian; Functional dependence and independence; Maxima and minima of functions of several variables (two and three variables) using Lagrange Multipliers.

TEXTBOOKS:

- Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8^{th} Edition,
- R.K.Jain and S.R.K.Iyengar Advanced Engineering Mathematics, Narosa Publications House.2008
- B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

REFERENCES:

- G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9^{th} Edition, Pearson,Reprint,2002.
- Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11^{th}Reprint, 2010.

- N.P. bail and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.

EC1101 **DIGITAL ELECTRONIC CIRCUITS**

(for ECE and CSE)

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

UNIT-I: Introduction

Digital & analog signals, Number System, BCD & its arithmetic, Binary, Decimal, Octal, Hexadecimal, Negative numbers& its arithmetic, Number base conversions,

Unit II: Logic Realization & Simplification:

Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes,Code Conversion. Logic Gates and its realization.

Unit III:Combinational Logic Design:

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU, parity generator, checker

Unit IV: Sequential Logic Design:

Building blocks like S-R, JK and Master-Slave JK FF, T-FF, D-FF and Flip-Flop conversions. Shift Registers (SISO, SIPO, PISO, PIPO), universal shift register.Synchronous and Asynchronous counters and it's realization.Programmable logic Families: PAL, PLA.PROM.

Unit V:Finite State Machines:

Design ofsynchronous FSM, Mealy model, Moore model, state diagrams and state reduction method, overlapping & Non-overlapping models.Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator.

Course outcomes:

At the end of this course students will demonstrate the ability to

5. A basic understanding of Boolean algebra and theorems for optimization

6. Design and developing of combinational logic circuits, storage cells for sequential circuit realization
7. Dissemination of sequential circuits for high end applications and FSM realizations
8. A glimpse on various logic families and their impacts in circuit realizations

TEXTBOOKS:

1. Switching & Finite Automata theory – Zvi Kohavi, TMH,2nd Edition.

2. Digital Design – Morris Mano, PHI, 3rd Edition, 2006.

3. Switching Theory and Logic Design-A.Anand kumar, 2008.

REFERENCES:

1. An Engineering Approach to Digital Design – Fletcher, PHI.

2. Fundamentals of Logic Design – Charles H. Roth, 5th Edition, 2004, Thomson Publications.

3. Digital Logic Applications and Design – John M. Yarbrough, 2006.

ME1102 ENGINEERING WORKSHOP

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **2-0-2-3**

- THEORY (Common for CSE, ECE, CE, EEE, MME and ME)

Course Objectives:

5. To understand the basic manufacturing process of producing a component by casting, forming plastic molding, joining processes, machining of a component either by conventional or by unconventional processes.
6. To understand the advanced manufacturing process of additive manufacturing process.

Course Outcome:

5. Students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

Module – 1:*Metal Casting*: Introduction, Tools, Types of Patterns, Pattern Materials, Types of casting – Sand, Die and other casting processes and Applications

Module – 2:*Metal Forming*: Introduction, Classification, Types of Bulk and sheet metal forming and Applications.

Module – 3:*Powder Metallurgy*: Introduction, Powder production methods, Compaction, Sintering, Secondary operations and Applications.

Module – 4:*Joining:* Types of Joining, Introduction to Welding, Brazing and soldering, Arc, Solid state welding processes.

Module – 5:*Conventional Machining processes*: Introduction to machining operations; Lathe operations, Drilling, Milling and Grinding.

Module – 6:*Unconventional Machiningprocesses*.

Module – 7:*CNC Machining and Additive manufacturing*

Text Books:

(i) Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

(ii) Kalpakjian S. and Steven S. Schmid, “Manufacturing Engineering and Technology”, 4th edition, Pearson Education India Edition, 2002.

- PRACTICALS (Common for CSE, ECE, CE, Chem, EEE and MME)

Course Outcomes: Upon completion of this laboratory course

6. Students will be able to fabricate components with their own hands.

List of Experiments:

1. Fitting – Step and V Fit

2.Carpentry – Half lap joint and Dove tail joint

3. House Wiring– Series, Parallel, Staircase and Godown wiring

4. Tin Smithy– Tray and Cylinder

5. Welding – Bead formation, Butt and Lap joint welding

6. Foundry– Mold preparation with Single piece and Split piece pattern

7. Machining – Plain turning, Facing, Step and Taper turning

8. Plastic molding – Demo

9. WIRE EDM, CNC, 3D Printer – Demo

Reference Books

(i)Gowri P. Hariharan and A. Suresh Babu,”Manufacturing Technology – I” Pearson Education, 2008.

(ii) Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998.

(iii) Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGrawHill House, 2017.

HS1101 COMMUNICATION SKILLS- I

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **2-0-0-0**

Objectives:

8. To make the students efficient communicators via experiential learning.
9. To enhance learners' analytical and creative skills, so that they will be capable to address a wide variety of challenges in their professional lives.
10. To help learners to improve the leadership qualities and professional etiquette
11. To expose learners to an effective communicative environment.

SYLLABUS:

Unit I – Introduction to communication

Introduction – Importance of Communication Skills – Definition – Scope and Nature – Verbal and Nonverbal communication

Unit II – Reading Skills

Reading Comprehension of unseen passage – Prose – News Paper Reading and Analysis (Editorial)

Unit III - Grammar

13. Parts of Speech
14. Subject and predicate
15. Articles – Determiners
16. Conjunctions (Linkers; connectors; cohesive devices)
17. Verbs – Transitive and Intransitive - Finite and Infinite - Regular and Irregular - Modals
18. Tenses
19. Prepositions/Prepositional verbs

20. Adverbs – types and their order in sentences
21. Adjectives
22. Including Degrees of Comparison and also Quantifiers

Unit IV – Enhancing Vocabulary

Developing Professional vocabulary – Using Dictionary: Spelling – Grammar and Usage

Unit V - Composition

Paragraph – Essay - Expansion - Describing the Pictures – Giving Directions – Situational Dialogue writing – Social and Professional Etiquette – Telephone Etiquette

OUTCOMES:

Students will be able to:

10. develop interpersonal communication, small group interactions and public speaking.
11. exercise the writing assignments, precise writing for informational, persuasive and creative purposes.
12. apply right form of structural usage of sentences in their written and oral communication.
13. develop confidence and skills related reading comprehension.
14. improve a logical framework for the critical analysis of spoken, written, visual and mediated messages upon a diverse platform.
15. demonstrate the ability to apply vocabulary in practical situations.

Suggested References:

17. Joseph Mylal Biswas book of English Grammar
18. R. Murphy -Cambridge Press
19. Wren and Martin
20. The Good Grammar book by OUP
21. Communication skills by M. Raman and Sangeeta Sharma
22. How to Win Friends and Influence People by Dale Carnigie
23. How to Read and Write Better by Norman Lewis
24. Better English by Norman Lewis
25. Use of English Collocations by OUP
26. www.humptiesgrammar.com
27. www.bbcactiveenglish.com
28. www.gingersoftware.com
29. www.pintest.com

CS1101 PROGRAMMING FOR PROBLEM SOLVING

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **3-0-0-3**

Objectives:

9. To introduce the basic concepts of Computing environment, number systems and flowcharts
10. To familiarize the basic constructs of C language – data types , operators and expressions
11. To understand modular and structured programming constructs in C
12. To learn the usage of structured data types and memory management using pointers
13. To learn the concepts of data handling using pointers

Detailed Contents:

UNIT-I: Introduction to Programming & Arithmetic expressions and precedence(8 Lectures)

Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) - (1 lecture).

Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. (1 lecture)

From algorithms to programs; source code, variables (with data types) variables andmemory locations, Syntax and Logical Errors in compilation, object and executable code- (2 lectures) Arithmetic expressions and precedence (2lectures).

UNIT-II: Conditional Branching , Loops & Arrays(12 Lectures)

Writing and evaluation of conditionals and consequent branching (3 lectures) Iteration and loops (3 lectures)

Arrays (1-D, 2-D), Character arrays and Strings(6 lectures)

UNIT-III: Function & Basic Algorithms(11 Lectures)

Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference(5 lectures)

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)(6 lectures)

UNIT-IV: Recursion &Structure(9 lectures)

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.(5 Lectures) Structures, Defining structures and Array of Structures(4 lectures)

UNIT-V: Pointers & File handling(7 lectures)

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation)

File handling (only if time is available, otherwise should be done as part of the lab)

Suggested Text Books

6. Byron Gottfried, Schaum's Outline of Programming with C,McGraw-Hill
7. E. Balaguruswamy, Programming in ANSI C, TataMcGraw-Hill

Suggested Reference Books

5. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.

Course Outcomes:

12. Formulate simple algorithms for arithmetic and logical problems.
13. Translate the algorithms to programs (in c language).
14. Test and execute the programs and correct syntax and logical errors.
15. Implement conditional branching, iteration and recursion.
16. Decompose a problem into functions and synthesize a complete program using divide and conquer approach.
17. Use arrays, pointers and structures to formulate algorithms and programs.
18. Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
19. Apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

EC1701 DIGITAL ELECTRONIC CIRCUITS LAB

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **0-0-3-1.5**

Course Objectives:

- To learn differences between analog systems and digital systems.
- To learn basic techniques for the design of digital circuits.
- To understand fundamental concepts used in the design of digital systems.
- To understand the concepts of various combinational and sequential circuits.
- To learn various techniques for logic circuit reduction.

LIST OF EXPERIMENTS:

- I/O characteristics of a Universal, Basic, Arithmetic gates
- Design of a digital comparator
- Check the functionality of a 1bit full adder circuit and subtractor
- Develop 4bit RCA
- Realize the functionalities of encoders and decoders
- Design sr-latch and flip flop
- Design jk-latch and flip flop
- Functioning of shift register, master slave flip flop, ALU
- Design of asynchronous and synchronous counters
- Verify the functionality of a n*1multiplexer and 1*n demultiplexer
- Design of a 7-segment LED display

Course Outcomes:

- Design, Analysis, Implementation and testing of logic gates and functions.
- An ability to analyze, implement and testing of combinational circuits.
- Design, Analysis, Implementation and testing of flip-flops and registers.
- An ability to analyze, implement and testing of counters.
- Design, Analysis, Implementation of application level projects.

CS1701 PROGRAMMING FOR PROBLEM SOLVING LAB

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-4-2**
Course Objectives

10. Understand the fundamentals of programming in CLanguage.
11. Write, compile and debug programs inC.
12. Formulate solution to problems and implement inC.
13. Effectively choose programming components to solve computingproblems

Detailed Contents:

List of Tutorials/Experiments:

Week 1

Tutorial 1: Problem solving using computers:

Lab1: Familiarization with programming environment

Week 2

Tutorial 2: Variable types and type conversions:

Lab 2: Simple computational problems using arithmetic expressions

- Write a C program to find the area of a circle using the formula: Area = PI *r2
- Write a C program to find the area and volume of sphere.
  (Formula are: Area =4*PI*R*R Volume =4/3*PI*R*R*R.)
- Write a C program to convertcentigradeinto Fahrenheit.
  (Formula: C=(F-32)/1.8.)
- Write a C program to read in twointegersand display one as a percentage of the other. Typically your output should looklike 20 is 50.00% of 40 assuming that the input numbers where 20 and 40. Display the percentage correct to 2 decimal places.

Week 3

Tutorial 3: Branching and logical expressions:

Lab 3: Problems involving if-then-else structures

9. Write a C program to find the maximum from given threenos.
10. Write a C program to find that the accepted no is Negative, Positive orZero.
11. Write a program which reads two integer values. If the first is lesser print the

message “up”. If the second is lesser, print the message “down” if they are equal, print the message “equal”if there is an error reading the data, print a message containing the word“Error”.

12. Write a C program that prints the given three integers in ascending order using if –else.
13. Given as input three integers representing a date as day, month, year, print the number day, month and year for the next day's date. Typical input: “28 2 1992” Typical output: “Date following 28:02:1992 is29:02:1992”

Week 4 & 5

Tutorial 4: Loops, while and for loops:

Lab 4: Iterative problems e.g., sum of series

9. Write a C program to find the sum of first 100 odd nos. and even nos.
10. Write a C program to display first 100 primenos.
11. Write a C program to read in a three digit number produce followingoutput

    (Assuming that the input is 347) 3 hundreds, 4 tens, 7 units

12. Write a C program to display Fibonacciseries
13. Write a C program to calculate the following i.sum=1-x2/2!+x4/4!-x6/6!+x8/8!-x10/10!+… ,

    ii.sum=x-x3/3!+x5/5!. ,

    iii.sum=1+x/1!+x^2/2!+x^3/3!. ,

14. Write a C program to find the roots of a Quadraticequation.

Week 6

Tutorial 5: 1D Arrays: searching, sorting:

Lab 5: 1D Array manipulation

7. C program that reads N integer numbers and arrange them in ascending order using BubbleSort
8. C program that reads N integer numbers and arrange them in ascending order

using selectionSort

9. C program that reads N integer numbers and arrange them in ascending order using insertion Sort
10. C program that reads N integer numbers and arrange them in ascending order using MergeSort

Week 7

Tutorial 6: 2D arrays and Strings

Lab 6: Matrix problems, String operations

8. Write a C program to perform the basic Matrixoperations
    a. Addition ii) Subtractioniii)Multiplicationiv)Transpose.
9. Write a C program to determine if the given string is apalindrome or not
10. Write a C program to count the lines, words and characters in a given text
11. Write a C program to search a word in a given sentence.

Week 8

Tutorial 7: Functions, call by value:

Lab 7: Simple functions

4. Write a C Function for the followingtask
    a. Calculating Factorial
    b. Find value of a given Fibonacciterm
    c. Swapping the values of twovariable

5. Write a C program that uses functions to performthe followingoperations:
    a. To insert a sub-string in to a given main string from a given position.
    b. To delete n Characters from a given position in a given string.

Week 9

Tutorial 10: Recursion, structure of recursive calls

Lab 10: Recursive functions

4 Write the following recursive CFunction

i)Factorial of a givennumber

ii)Nth Fibonaccinumber

iii)Reverse of a givenString

iv)Reverse of a givenNumber

Week10

Tutorial 11: Pointers, structures and dynamic memory allocation

Lab 11: Pointers and structures

10. Write a C program to maintain a record of "n" student detailsusing an array of structures with four fields (Roll number, Name, Marks, and Grade). Assume appropriate data type for each field. Print the marks of the student, given the student name asinput.
11. Define structure called cricket that will describe the information player name, team name,batting aveg.Using cricket ,declare an array player with 10 elements and write program to read information about all 10 players and print team wise list containing names of the player with their battingavg
12. Write a program using pointers to compute the sum of all elements sorted in anarray
13. Write a program to print the elements of a structure usingpointers.

Week11

Tutorial 12: File handling

Lab 12: File operations

8. Write a C program that creates an Employee text file? RecordsAre empid, empname, designation, qualification, salary, experience, Research work, address, cityphone?

9. Write a C program that manipulates the above text file. The program must implements the operation to modify a record, delete a record and append newrecords

Course Outcomes

10. Choose appropriate data type for implementing programs in Clanguage.
11. Design and implement modular programs involving input output operations,decision making and loopingconstructs.
12. Implement search and sort operations onarrays.
13. Apply the concept of pointers for implementing programs on dynamic memory management and stringhandling.
14. Design and implement programs to store data in structures andfiles.

Suggested Books:

9. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
10. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill Suggested Reference Books
11. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

II SEMESTER

EE1203 BASIC ELECTRICAL ENGINEERING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **4-0-0-4**

<u>Course Objectives</u>

16. To explain the basic concepts and laws of DC and AC electrical networks and solve them using mesh and nodal analysis techniques.

17. To introduce students with the fundamental concepts in graph theory.
18. To analyse circuits in time and frequency domain.
19. To explain concepts of driving point and transfer functions, poles and zeroes of network function and their stability.
20. To synthesize the network using passive elements.
21. To analyse the transformers and coupled circuits.
22. To analyse the DC and AC generators & motors with applications.

UNIT-1

Introduction of Networks: Mechanism of electrical energy flow through the conductor and basic ohm's law, passive lumped R, L, C's and ohm's law, types of elements, sources, Kirchhoff's laws, Nodal and Mesh Analysis Techniques, Equivalent circuits with respect to passive R, L, C's, equivalent circuits with respect to active sources, source transformation technique, Power calculation by tellegen's theorem.

Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power Transfer, compensation, Duality, Milliman's and Tellegen's theorem as applied to AC & DC circuits. Graph Theory: Complete graph or standard graph, connected graph, sub graph, tree of a graph, co-tree (complemented tree), planar graph etc. Incidence matrix, Fundamental loop matrix or tie set matrix, cut set matrix and its properties.

UNIT-2

Introduction to Transient Analysis: Classification of transients, DC transients: source free circuits (source free RL, RC, RLC circuits), with sources, initial and final conditions, Laplace transform approach (LTA) for solving transient problems. AC transients: steady state response and transient free condition for RL, RC, and RLC circuits.

AC circuit analysis: Sinusoidal steady state analysis by using phasors, phasor diagrams, concept of resonance or frequency domain analysis of RLC circuits. Average and RMS values of periodic signals, power calculations, locus or circle diagrams. Filters (LPF, HPF, BPF, BSF, APF) or frequency domain analysis of RL, RC, RLC circuits, state equations for networks, transmission criteria.

UNIT-3

Two-Port networks: Symmetric and reciprocal networks. Z, Y, h, g, ABCD, A'B'C'D' parameters and it's equivalent circuit representations. Cascade connection of 2-two port networks, Two port network representation for ideal transformer. Inter relationships between parameters of two port network, proofs for symmetry and reciprocity conditions. Inter connection of two port networks (series and parallel two port networks). T and π representations, lattice networks, image parameters, ladder networks

Network Synthesis: Network functions, pole and zero's, one port network, driving point impedance and driving point admittance functions. Realizations or synthesis: Foster Form-I, Foster Form-II, Cauer Form-I, Cauer Form-II, properties of driving point immittance function, Properties of RC DP, RL DP functions & necessary conditions for PR (Positive Real) function, properties of Hurwitz polynomial function.

UNIT-4

Coupled circuits: Analysis of coupled circuits, self-inductance, mutual inductance, coefficient of coupling, series connection of coupled coils, modelling of coupled circuits, dot convention in coupled coils. Electrical equivalent of magnetically coupled circuits, tuned coupled circuits (single tuned and double tuned coils), example problems.

Transformers: Working Principle, construction, classification: core and shell types, theory on no load, e.m.f. equation, turns ratio, voltage ratio and current ratio, losses and efficiency, equivalent resistance, reactance and impedance, voltage regulation, constants of transformer, open circuit and short circuit tests, predetermination of efficiency and regulation, all-day efficiency, auto-transformer: saving of copper, practical applications.

UNIT-5:

DC Generator: Basic principle, construction, rectifying action of commutator, armature windings: LAP and WAVE, classification of generators: shunt, series and compound, E.M.F. equation, generator on load, operating characteristics, critical resistance, concepts of armature reaction and commutation, practical applications. DC Motor: Principle of operation, back e.m.f. speed and torque equations, mechanical power developed, classification of motors: series, shunt and compound, operating characteristics, speed control, practical applications, motor starter: its necessity, 3-point starter, losses and efficiency.

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction and working of synchronous generators.

Course Outcomes

11. apply the knowledge of basic circuital law and simplify the network using reduction techniques.
12. Analyse the circuit using Kirchhoff's law and Network simplification theorems
13. Infer and evaluate transient response, Steady state response, network functions
14. Obtain the maximum power transfer to the load, and Analyse the series resonant and parallel resonant circuit.
15. evaluate two-port network parameters, design attenuators and equalizers
16. Synthesize one port network using Foster and Cauer Forms.

17. Analyse the transformers and coupled circuits.
18. Analyse the DC and AC generators & motors with applications.

Text Books:

8. Van, Valkenburg.; "Network analysis" ; Prentice hall of India, 2000.
9. A William Hayt, "Engineering Circuit Analysis" 8th Edition, McGraw-Hill Education.
10. "A Textbook of Electrical Technology" by B L Theraja and A K Theraja.
11. "Basic Electrical and Electronics Engineering" by S K Bhattacharya.

Reference Books:

11. Sudhakar, A., Shyammohan, S. P.; "Circuits and Network"; Tata McGraw-Hill NewDelhi, 1994.
12. Kuo F. F., "Network Analysis and Synthesis", 2nd Ed., Wiley India., 2008.
13. "Principles of Electrical Engineering and Electronics" by Mehta V K and Mehta Rohit.
14. Electrical Technology by Yoganarasimhan.

MA1201 DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-1-0-4**

Learning Objectives:

10. Methods of solving the differential equations of first and higher order.
11. To study the methods of solving improper integrals and the concepts of multiple integrals
12. The basic properties of vector valued functions and their applications to line, surface and volume integrals
13. To study numerical methods to analyze an experimental data.

Learning Outcomes:

At the end of the course student will be able to

8. Solve first order linear differential equations and special non linear first order equations like Bernouli , Riccati &Clairaut's equations
9. Compute double integrals over rectangles and type I and II" regions in the plane
    iv. Explain the concept of a vector field and make sketches of simple vector fields in the plane.
    iv. Explain concept of a conservative vector field, state and apply theorems that give necessary and sufficient conditions for when a vector field is conservative, and describe applications to physics.
    iv. Recognize the statements of Stokes' Theorem and the Divergence Theorem and understand how they are generalizations of the Fundamental Theorem of Calculus.
    v. Able to solve the problems in diverse fields in engineering science using numerical methods.

UNIT-I

Ordinary Differential Equations of first order: Exact first order differential equation, finding integrating factors, linear differential equations, Bernoulli's , Riccati , Clairaut's differential equations, finding orthogonal trajectory of family of curves, Newton's Law of Cooling, Law of Natural growth or decay.

UNIT-II

Ordinary Differential Equations of higher order:

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type $e^{ax}, sin(ax), cos(ax)$, polynomials in$x, e^{ax}V(x), xV(x)$; method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

UNIT-III

Integral Calculus:

Evaluation of the double integrals (Cartesian and Polar), change of order of integration (only Cartesian form), Evaluation of Triple integrals. Change of variables (Cartesian to polar) in case of double integrals (Cartesian to spherical and cylindrical) in case of Triple Integrals-Jacobians of transformations. Differentiation of integrals with variable limits - Leibnitz rule.

Applications: Finding Areas (using double integrals) and volumes (using double and Triple Integrals), Centre of mass, Centre of gravity for constant and variable densities by double and triple integrals (applications involving cubes, Sphere and rectangular parallelepiped)

UNIT-IV

Vector Differentiation:Vector point functions and scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal line. Vector Identities. Scalar potential functions. Solenoidal and Irrotational vectors.

UNIT-V

Vector Integration: Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

Numerical Methods: Introduction and motivation about numerical methods, True value, approximate value, error, error percentage, algebraic equations, transcendental equations, Newton-Raphson method, Bisection method.

Text Books:

1.Advanced Engineering Mathematics (3rd Edition) by R. K. Jain and S. R. K. Iyengar, Narosa Publishing House, New Delhi

References Books

1. Advanced Engineering Mathematics (8th Edition) by Erwin Kreyszig, Wiley-India.

2. Dr. M.D. Raisinghania,Ordinary andPartialdifferentialequations,S.CHAND,17th Edition2014.

PH1202 **PHYSICS**

Internals: 40 Marks **L - T - P - C**
Externals: 60 Marks **3 - 1 - 0 - 4**

Total Number of Modules: 41 (One Module ~ 1 to 1.5 hours of Lecture hours)

UNIT I: Vectors and Mathematical Physics (5)
Gradient, Divergence, Curl and its applications .Line, surface and volume integrals, Stokes and Gauss theorem, Curvilinear Coordinates: Polar, Cylindrical and spherical polar co-ordinates, Problems.

UNIT II: Quantum Mechanics (6)
Introduction to Quantum Mechanics, De-Brogile waves and uncertainity principle, Time dependant Schrodinger wave equation, Significance of Wave Function, Time independent Schrodinger wave equation and solution of generalized potential, Particle in a box, Quantized energies, Problems.

UNIT III: Electron Structure of solids (6)
Introduction to Crystallography, Bravais Lattices, Basis, Unit Cell, Miller Indices, Electron Theory, Kronig Penny model (E vs K), Band theory of solids.

UNIT -IV :Conductive Materials and Dielectrics (10 + 4)
Electrical Conductivity
Free electron Theory of metals, Joule's Law, Relaxation Time, Collision time, Mean free path, Factors effecting electrical conductivity, Applications of conducting materials
Thermal Conductivity
Thermal conductivity of metals, Wiedemann-Franz Law, Thermoelectric phenomenon
Superconductors
Superconductivity, Properties of Superconductors, Types of Super conductors, Applications of Superconductors.
Dielectrics
Introduction to Dielectrics, Homogentity, Isotropy, Linearity, Types of Polarisation, Internal fields, Classification of dielectric materials based on dielectric behaviour and special feautures.

UNIT V: Semiconductor Materials (10)
Electrical conductivity of metals, semiconductors and insulators, Electrons and holes in an Intrinsic semiconductor (Pure), Extrinsic materials, Mechanism of current flow in a semiconductor, Charge densities, Electrical properties of semiconductors, Hall Effect, Thermistors, Photoconductors, Generation and recombination of carriers, Recombination and Diffusion, Total current (Diffusion and Drift), Electrical properties of semiconductor.

Reference books:
1. Arfken, Mathematical Physics

2. David Griffiths, Quantum Mechanics

3. Wahab, Solid State Physics

4. S M Sze, Semiconductor Devices: Physics and Technology, Wiley (2008)

5. P.K.Palaniswamy, Applied Physics

CE1801 **ENGINEERING GRAPHICS**

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **1-0-4-3**

Course Objectives:

vi. To introduce the students to the "Universal Language of Engineers" for effective communication through drawing.
vii. To understand the basic concepts of drawing through modern techniques.
viii. To impart knowledge about standard principles of projection of objects.
ix. To provide the visual aspects of Engineering drawing using Auto-CAD.

UNIT-I:(15 Hours)

Introduction to Engineering Drawing: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, types of lines and Dimensioning.
Over view of Auto-CAD: Theory of CAD software (The Menu System, Tool Bars, drawing area, Dialogue boxes, Shortcut Menu, the command lines, Select and erase objects, Introduction to layers etc.), Drawing simple figures- lines, planes, solids.

UNIT-II: (10 Hours)

Geometrical constructions: Construction of regular polygons.
Conic sections: Construction of Ellipse, Parabola, Hyperbola (General method only), Cycloid, Epicycloid, Hypocycloid and Involutes.
Scales: Construction of Plain, Diagonal and Vernier scales.

UNIT-III: (20 Hours)

Orthographic projections: Principles of Orthographic Projections
Projections of Points: Projections of Points placed in different quadrants
Projection of lines: lines parallel and inclined to both the planes (Determination of true lengths and true inclinations and traces)
Projection of planes: Planes inclined to both the reference planes

UNIT-IV: (15 Hours)

Projection of Solids: Projection of solids whose axis is parallel to one of the reference planes and inclined to the other plane, axis inclined to both the planes

Projection of sectioned solids: Sectioning of simple solids like prism, pyramid, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.

UNIT-V: (12 Hours)

Development of surfaces:Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone
Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views of planes and simple solids
Perspective projections: Basic concepts of perspective views.

Course Outcomes:

At the end of the course, the student will be able to

9. Use Engineering principles and techniques to understand and interpret engineering drawings.
10. Understand the concepts of Auto-CAD.
11. Draw orthographic projections of lines, planes and solids using Auto-CAD.
12. Use the techniques, skills and modern engineering tools necessary for engineering practices.

Text/Reference Books:

ix. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
x. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
xi. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
xii. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age publications
xiii. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
xiv. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
xv. (Corresponding set of) CAD Software Theory and User Manuals

HS1201 **ENGLISH**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **2-0-0-2**

INTRODUCTION:

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic, communicative and critical thinking competencies of Engineering students. In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts leading to reading comprehension and different passages may be given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material etc. *The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures.* **Course Objectives:** The course will help to

9. Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
10. Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
11. Develop study skills and communication skills in formal and informal situations.

Unit –I: 'The Raman Effect' from the prescribed textbook 'English for Engineers' published byCambridge University Press.

Vocabulary Building: The Concept of Word Formation --The Use of Prefixes and Suffixes.Grammar: Identifying Common Errors in Writing with Reference to Articles andPrepositions.Reading: Reading and Its Importance- Techniques for Effective Reading.Basic Writing Skills: Sentence Structures -Use of Phrases and Clauses in Sentences Importance of Proper Punctuation- Techniques for writing precisely – Paragraph writing –Types, Structures and Features of a Paragraph - Creating Coherence-Organizing Principles ofParagraphs in Documents.

Unit –II: 'Ancient Architecture in India' from the prescribed textbook 'English for Engineers'published by Cambridge University Press.

Vocabulary: Synonyms and Antonyms.Grammar: Identifying Common Errors in Writing with Reference to Noun-pronounAgreement and Subject-verb Agreement.Reading: Improving Comprehension Skills – Techniques for Good ComprehensionWriting: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint,Letter of Requisition, Job Application with Resume.

Unit –III: 'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.

Vocabulary: Acquaintance with Prefixes and Suffixes from Foreign Languages in English toform Derivatives-Words from Foreign Languages and their Use in English.Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiersand Tenses.Reading: Sub-skills of Reading- Skimming and ScanningWriting: Nature and Style of Sensible Writing- Defining- Describing Objects, Places andEvents – Classifying- Providing Examples or Evidence

Unit –IV: 'What Should You Be Eating' from the prescribed textbook 'English for Engineers'published by Cambridge University Press.

Vocabulary: Standard Abbreviations in EnglishGrammar: Redundancies and Clichés in Oral and Written Communication.Reading: Comprehension- Intensive Reading and Extensive ReadingWriting: Writing Practices--Writing Introduction and Conclusion - Essay Writing-PrécisWriting.

Unit –V: 'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'Englishfor Engineers' published by Cambridge University Press.

Vocabulary: Technical Vocabulary and their usageGrammar: Common Errors in EnglishReading: Reading Comprehension-Exercises for PracticeWriting: Technical Reports- Introduction – Characteristics of a Report – Categories ofReports Formats- Structure of Reports (Manuscript Format) -Types of Reports - Writing a Report.

Course Outcomes: Students should be able to
Use English Language effectively in spoken and written forms.

- Comprehend the given texts and respond appropriately.
- Communicate confidently in various contexts and different cultures.
- Acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Prescribed Textbook:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

References:

- Swan, M. (2016). Practical English Usage. Oxford University Press.
- Kumar, S and Lata, P.(2018). Communication Skills. Oxford University Press.
- Wood, F.T. (2007).Remedial English Grammar. Macmillan.
- Zinsser, William. (2001). On Writing Well. Harper Resource Book.
- Hamp-Lyons, L. (2006).Study Writing. Cambridge University Press.
- Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

HS1202 **Communication Skills II**

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **2-0-0-0**

Objectives:

9. To develop the learners ability to read fluently and critically.
10. To make awareness of the common punctuation marks and the importance of it in writing
11. To build academic vocabulary of the learners
12. To offer the learners opportunity to practice creative writing
13. To make the learners apply the skills and strategies of a successful listener

Unit I – Reading

Reading Skills – Importance - Definition –Types -Techniques and strategies

Unit II – Punctuation and Capitalization

Punctuation - Use of Capital Letters

Unit III – Vocabulary

- Antonyms
- Synonyms
- Affixation
- Vocabulary in context
- Proverbs /Collocations
- One word substitutes
- Idioms and Phrasal verbs

Unit IV – Writing Skills
Creative writing – Story Writing – Precise - Letter writing
Unit V - Listening

Listening Skills – Academic Listening – Listening to Talks and Presentations – Note Taking

Course Outcomes:

The learners will be able to:

3. Make use of contextual clues to infer meanings of unfamiliar words from context and make inferences and predictions based on comprehension of a text
7. Punctuate simple sentences correctly
8. Produce appropriate vocabulary and correct word forms;
9. Write creatively and accurately. They will also have a critical awareness of their writing in terms of unity, content, coherence and linguistic accuracy (grammatical structure and choice of vocabulary).
10. Comprehend the talks and presentations, take organized notes on lectures and listening passages

References:

- Meenakshi Raman and Sangeeta Sharma *"Communication skills"* Oxford University press, 2013
- Wren and Martin, NDV Prasad Rao. *"High School English Grammar and Composition*" S. Chand& Compay Ltd, 2012
- Michael Swan, *"Practical English Usage"* 3rd edition: guide to problems in English, Oxford University press, 2011
- Edgar Thorpe and Showick Thorpe, *"Objective English"* 3rd Edition, Pearson, 2010

EE1803 BASIC ELECTRICAL ENGINEERING LAB

External:60 Marks	**L-T-P-C**
Internal:40 Marks	**0-0-3-1.5**

COURSE OBJECTIVES: To provide practical exposure to

- Prepare the students to have a basic knowledge in the analysis of Electric Networks.
- Solve the given circuit with various theorems and methods.
- Relate various two port parameters and transform them.
- Common electrical components, their ratings and applications.
- Common electrical measuring instruments and their usage.
- Transformers and electrical machines.

LIST OF EXPERIMENTS

NT LAB EXPERIMENTS:

1. Verify KCL and KVL for DC circuits.

2. Verify mesh and nodal analysis for DC circuits.

3. Determine and verify superposition theorem.

4. Determine and verify Thevenin's and Norton's theorem.

5. Determine and verify Maximum power transfer theorem.

6. Calculate and verify 'Z' ,'Y', h' and 'g' parameters of two-port network.

ET LAB EXPERIMENTS:

1.Introduction to Lab:

(a).Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.

(b).Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.

(c).Demonstration of Components of LT switchgear.

2.Transformers: Observation of the no-load current waveform on an oscilloscope (non sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).Loading of a transformer: measurement of primary and secondary voltages and currents, and power.

3.Three-phase transformers: Star and Delta connections. Voltage and Current relationships(line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.

4. Series Resonance in R-L-C circuits.

5. Study and plot the transient Response of RL, RC circuit.

<u>COURSE OUTCOMES:</u>

At the end of the course student will have ability to

- Articulate in working of various components of a circuit.
- Familiar with ac and dc circuits solving.
- Ready with the most important concepts like mesh and nodal analysis.
- Express given Electrical Circuit in terms of A,B,C,D and Z,Y Parameter model and solve the circuits.
- Understand principles of measuring instruments of voltage, current and power
- Analyze the characteristics and evaluate performance of DC Motor, induction motor and transformers

PH1802 PHYSICS LAB

Externals: 60Marks L-T-P-C

Internals: 40Marks 0-0-3-1.5

List of Experiments:

11. Band Gap of a semiconductor
12. Hall effect
13. Frank Hertz experiment
14. Photoelectric effect
15. Seebeck and Peltier effect
16. Dielectric constant
17. Solar Cell
18. Compton effect

HS1801 **ENGLISH LANGUAGE LAB**

Orals (Written): 50Marks **L-T-P-C**
Written (Externals): 50Marks **0-0-2-1**

The Language Lab focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

Course Objectives:

11. To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
12. To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm.
13. To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
14. To improve the fluency of students in spoken English and neutralize their mother tongue influence
15. To train students to use language appropriately for public speaking and interviews

Syllabus of English Language Lab (Computer Assisted Language Learning (CALL) Lab):

Listening Skills:

Objectives:

5. To enable students, develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation
6. To equip students with necessary training in listening so that they can comprehend the

speech of people of different backgrounds and regions.

Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

Speaking Skills:

Objectives:

8. To involve students in speaking activities in various contexts
9. To enable students express themselves fluently and appropriately in social and professional contexts

- Oral practice: Just A Minute (JAM) Sessions
- Describing objects/situations/people
- Role play – Individual/Group activities

The following course content is prescribed for the English Language and based on AICTE Model Curriculum 2018 for B.Tech First year. As the syllabus is very limited, it is required to prepare teaching/learning materials by the teachers collectively in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning and timesaving in the Lab.

Unit – I:

Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening - Communication at Work Place- Spoken vs. Written language.

Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants -Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

UNIT-II

Understand: Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context- Features of Good Conversation – Non-verbal Communication.

Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context-Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

UNIT-III

Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI)- How to make Formal Presentations.
Practice: Common Indian Variants in Pronunciation – Differences in British and American Pronunciation- Formal Presentations.

UNIT-IV
Understand: Listening for General Details-Public Speaking – Exposure to Structured Talks.
Practice: Listening Comprehension Tests- Making a Short Speech – Extempore
UNIT-V
Understand: Listening for Specific Details- Interview Skills.
Practice: Listening Comprehension Tests- Mock Interviews.

Learning Outcomes: Students will be able to attain

8. Better understanding of nuances of English language through audio- visual experience and group activities
7. Neutralization of accent for intelligibility
8. Speaking skills with clarity and confidence which in turn enhances their employability skills

Suggested References:

10. Clarity English Success - Software
11. Connected Speech- Software
12. Issues in English 2- Software
13. http://www.clarityenglish.com/program/practicalwriting/
14. http://www.clarityenglish.com/program/roadtoielts/
15. http://www.clarityenglish.com/program/clearpronunciation1/
16. http://www.clarityenglish.com/program/resultsmanager/

III SEMESTER

CY2102	**CHEMISTRY**	
Externals: 60Marks		**L-T-P-C**
Internals: 40Marks		**3-0-0-3**

Unit I: Spectroscopy

Introduction to spectroscopy, electromagnetic radiations, different types of spectroscopy, principle of spectroscopy, spectrophotometer Microwave spectroscopy: principle, microwave spectra of diatomic molecules, selection rules for microwave spectra, applications of microwave spectroscopy: determination of bond length, dipole moment measurement, determination of isotopic mass of an element. Infrared spectroscopy: introduction and principles of IR, types of vibrations: bending and stretching, Hooke's law for stretching vibrations, characteristic frequencies of common functional groups, IR instrumentation, interpretation and applications of IR spectrum with examples.

Ultra-violet spectroscopy: Introduction and principle of UV spectroscopy, color interpretation with VBT and MOT, types of electronic transitions, selection rules, chromophores and auxochromes with examples, conjugation effect, absorption and intensity shifts, applications of UV spectroscopy.

Unit II: Chemical kinetics

Complex reactions: definition and classification of complex reactions, definition of reversible reactions with examples, rate law derivation for reversible reactions. Consecutive reactions: definition, rate law derivation and examples of consecutive reactions.Parallel reactions: definition, rate law derivation and examples of parallel reactions.Steady-state approximation: introduction, kinetic rate law derivation by applying steady state approximation in case of the oxidation of NO and pyrolysis of methane. Chain reactions: introduction, types and mechanism of chain reactions, stationary and non-stationary chain reactions with examples, deriving the kinetic rate equation using a general chain reaction. Photochemical reactions: introduction, Stark-Einstein law of photochemical equivalence, photophysical processes: IC, ISC, fluorescence and phosphorescence with examples, kinetic rate law derivation incase of photochemical decomposition of HI and photochemical combination of H_2 and Br_2.

Unit III: Electrochemistry

Types of electrodes: introduction, metal-metal ion electrodes, metal-insoluble salt-anion electrodes, calomel electrode, gas-ion electrodes, hydrogen and chlorine electrodes, oxidation-reduction electrodes, amalgam electrodes.
Types of cells: classification into chemical and concentration cells, chemical cells with transference and without transference, classification of concentration cells into electrolyte and electrode concentration cells, electrolyte concentration cells with and without transference, amalgam and gas concentration cells, examples for these cells.

EMF and applications of EMF: determination of pH, determination of the valency of the ions, potentiometric titrations. pH: definition of pH and determination of pH by various methods, acid-base titrations. Thermodynamic data: enthalpy and entropy of cell reactions, Gibbs-Helmholtz equation and applications.

Unit IV: Corrosion and its prevention

Mechanism of Dry and wet corrosion (rusting of iron), Types of corrosion, galvanic corrosion, stress corrosion, pitting and crevice corrosion. Factors affecting corrosion, preventive measures (proper design, Cathodic and Anodic protection, Electroplating, tinning, galvanizing.

Unit V: Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecules like Aspirin, Ibuprofen.

Unit VI: Phase Rule:

Terminology, one component system (H_2O system, S- system and CO_2 – system), two components system, Cooling curves, simple eutectic system (Pb – Ag), system with congruent melting point (Zn – Mg).

Unit VII: Engineering Materials:

Polymers: Types of Polymerization (Chain & Step growth). Plastics: Thermoplastic & Thermo setting resins; Preparation, properties,engineering applications of PVC, Teflon and Bakelite.

Lubricants: Classification with examples-Characterstics of a good lubricant & mechanism of lubrication (thick film, thin film and extreme pressure) –properties of lubricants: viscosity, Cloud point, flash and fire points.

Refractories: Classification, characteristics of a good refractory and applications.

Nanomaterials: Introduction, preparation by sol-gel & chemical vapour deposition methods. Applications of nanomaterials.

Refer Books

7. Engineering Chemistry, Jain & Jain
8. Engineering Chemistry, Shashi Chawla
9. Chemistry for Engineers, B. K. Ambasta
10. Engineering Chemistry, H. C. Srivastava

EC2102 ELECTRONIC DEVICES AND CIRCUITS

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-1-0-4**

<u>Course Objectives:</u>

9. To introduce the fundamental concepts of semiconductor materials and its characteristics.
10. Identify the whether the semiconductor material is p-type or n-type by using Hall Effect.
11. To understand the basic structure of p-n junction diode and Tunnel diode it’s working principles.
12. To understand the applications of Bipolar Junction Transistor and Unipolar Junction Transistor and its different modes of operation.
13. To understand the basics of optical electronics like Photo detectors, Photoluminescence, Electroluminescence, Led and laser.
14. To understand the basic IC fabrications & Logic families.

<u>UNIT-1</u>

Semiconductor Physics: Review of semiconductor physics. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equation, Hall effect.

Diodes:Qualitative Theory of P-N Junction, P-N Junction as a Diode, Diode Equation, Volt- Ampere Characteristics, Temperature dependence of V-I characteristic, Ideal versus Practical – Resistance levels(Static and Dynamic), Transition and Diffusion Capacitances, Diode Equivalent Circuits, Load Line Analysis, Breakdown Mechanisms in Semiconductor Diodes, Zener Diode Characteristics and its applications.

UNIT-2

Rectifiers and Filters: The P-N junction as a Rectifier, Half wave Rectifier, Full wave Rectifier, Bridge Rectifier, Harmonic components in a Rectifier Circuit, Inductor Filters, Capacitor Filters, L- Section Filters, π- Section Filters, Comparison of Filters.

Opto-Electronics: Optical sources: LED, LASER. Direct & Indirect band gap semiconductors. Optical detectors: Photo diode, Pin diode, Avalanche Photo Diode (APD), Solar cell, LCD.

UNIT-3

Bipolar Junction Transistor: The Junction Transistor, Transistor Current Components, Transistor as an Amplifier, Transistor Construction, non-ideal effects of BJT: Base width modulation, Emitter band gap narrowing, non-uniform base doping, breakdown voltage. BJT Operation, Common Base, Common Emitter and Common Collector Configurations, Limits of Operation, BJT Specifications.

Transistor Biasing and Stabilization: Operating Point, The DC and AC Load lines, Need for Biasing, Fixed Bias, Collector Feedback Bias, Emitter Feedback Bias, Collector - Emitter Feedback Bias, Voltage Divider Bias, Bias Stability, Stabilization Factors, Stabilization against variations in V_{BE} and β, Bias Compensation using Diodes and Transistors, Thermal Runaway, Thermal Stability.

UNIT-4

Field Effect Transistor: The Junction Field Effect Transistor (Construction, principle of operation, symbol) – Pinch-off Voltage - Volt-Ampere characteristics, The JFET Small Signal Model, MOSFET (Construction, principle of operation, symbol), MOSFET Characteristics in Enhancement and Depletion modes.

FET Amplifiers: FET Common Source Amplifier, Common Drain Amplifier, Generalized FET Amplifier, Biasing FET, FET as Voltage Variable Resistor, Comparison of BJT and FET.

UNIT-5

Special Purpose Electronic Devices: Principle of Operation and Characteristics of Tunnel Diode (with the help of Energy Band Diagram), Varactor Diode, Schottky Barrier diode, Point contact diode.

Power Switching Devices: Introduction to: SCR, UJT, DIAC, TRIAC and its applications.

Course Outcomes:

At the end of this course students will demonstrate the ability to

- Students will be good at fundamental concepts of semiconductor materials and its characteristics.
- Students will be ability to identify the whether the semiconductor material is p-type or n-type by using Hall Effect.
- Students will be good at the basic structure of p-n junction diode and Tunnel diode it's working principles.
- Students will know the applications of Bipolar Junction Transistor and Unipolar Junction Transistor and its different modes of operation.
- Students will be good at the basics of optical electronics like Photo detectors, Photoluminescence, Electroluminescence, Led and laser.
- Students will be having knowledge on basic IC fabrications & logic families.

Text Books:

5. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.
6. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education.
7. Jacob Millman, Christos C Halkias and Satyabrata JIT, " Electronics Devices and Circuits", 3rd Edition.

Reference Books:

10. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley&Sons, 2006.
11. C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
12. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

EC2103 **SIGNALS AND SYSTEMS**

(only for ECE)

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**3-0-0-3**

UNIT I: Introduction to Signals and Systems

Signals and systems as seen in everyday life, and in various branches of engineering and science. Continuous and discrete time signals, Analog and Digital signals and some special signals of importance: the unit step, the unit impulse, the sinusoid, the complex exponential, some special time-limited signals; Signal properties: periodicity, absolute integrability, determinism and stochastic character, energy and power, odd and even, Operations on independent variables of the signal: Time shifting, reversal, scaling; System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability with examples.

Unit II: Behavior of continuous and discrete-time LSI systems

Impulse response and step response, convolution with examples, cascade interconnections. Characterization of causality and stability of LSI systems. System representation through differential equations and difference equations. Periodic inputs and semi periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response. notion of eigen functions of LSI systems, a basis of eigen functions.

Unit III: Fourier Transform

The idea of signal space and orthogonal bases, Fourier series representation of periodic signals with examples, Waveform Symmetries. Continuous Time Fourier Transform and it's properties including Parseval's Theorem and Duality, magnitude and phase response, The DiscreteTime Fourier Transform (DTFT). Ideal Filters, R-C first order LPF, HPF, BPF circuits and its frequency domain analysis using transfer function.

Unit IV: Laplace Transform

Review of the Laplace Transform for continuous time signals and systems, Region of Convergence, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. Butterwoth LPF, HPF and BPF and its realization.

Unit V: Sampling and Reconstruction

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems.

Course outcomes:

At the end of this course students will demonstrate the ability to

v. Analyze different types of signals
vi. Represent continuous and discrete systems in time and frequency domain using different transforms
vii. Investigate whether the system is stable
viii. Sampling and reconstruction of a signal

Text/Reference books:

2. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
3. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
4. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
5. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.

6. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
7. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
8. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
9. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
10. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
11. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.

EC2901 ELECTRONICS MINI PROJECT-I

L-T-P-C
0-0-2-1

Topics:

Analog Filter Design:

a. Butterwoth, Chebyschev, Elliptic filter design for LPF, HPF, BPF, BSF (Need to verify with MultiSim software and realize the same using passive components)
b. Concepts related to Instrumentation and Measurements

MA2104 TRANSFORM CALCULUS AND COMPLEX ANALYSIS

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**3-1-0-4**

Course objectives: To make Students learn concepts and methods described in the syllabus, so that they will be able to solve their engineering problem using linear algebra, functions of complex variable wherever applicable. They will come to know a number of applications of linear algebra, and especially they will learn about SVD and applications to image processing.

Also make them learn fair amount of calculus of functions of complex variables, like complex differentiation and integration and residue calculus which is will become a handy tool for definite integration for them.

To Solve the Differential & integral equations using Laplace Transform.
To know the Applications of Laplace Transforms.

Learning Outcomes: At the end of the course the student will be able to

8. Use shifting theorems to compute the Laplace transform and inverse Laplace transform
9. Solve Differential equations and Partial differential equations using Laplace Transforms.
10. Write the LU, QR, SVD decompositions for given matrices.
11. Finding the Orthogonal basis for a given Inner Product space.
12. Evaluate improper real integrals using Residue theorem.
13. Find the Fourier series for a given function.
14. Apply Fourier Transform to solve the differential and Partial Differential Equations.

UNIT-I

Complex Variable – Differentiation
Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding Harmonic conjugate; Elementary analytic functions (exponential, trigonometric, logarithm) andtheir properties; Conformal mappings, Mobius transformations and their properties

UNIT-II

Complex Variable-Integration
Contour integrals, Cauchy-Goursat theorem (without proof), and Cauchy Integral formula (withoutProof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series,Zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem(Without proof), Evaluation of

definite integral involving sine and cosine functions .Evaluation of certainimproper integrals using the Bromwich contour

Unit-III

Laplace Transform: Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function. Differentiation and integration of transforms, convolution theorem.
Inverse Laplace Transform, periodic functions. Evaluation of integrals by Laplace Transform. Solution of initial and boundary value problems and solving Differential Equations & Integral Equations.

UNIT-IV

Fourier Series: Periodic functions, Fourier series representation of a function, half range series, sine and cosine series, Fourier integral formula, Parseval's identity

UNIT-V

Fourier Transform:

Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self-reciprocity of Fourier Transform, convolution theorem.
Applications to boundary value problems

Text Books:

- Introduction to Linear Algebra ,Gilbert Strang fourth edition
- Advanced Engineering Mathematics (3rd Edition) by R. K. Jain and S. R. K. Iyengar, Narosa Publishing House, New Delhi
- B.S. Grewal and J.S. Grewal, “Higher Engineering Mathematics”,(40th Edition), Khanna Publishers,2007

References Books:

- Advanced Engineering Mathematics (8th Edition) by Erwin Kreyszig, Wiley-India.
- Dr. M.D. Raisinghania,Ordinary and Partialdifferentialequations,S.CHAND,17thEdition2014.
- R.V.Churchill, “ Complex Variables & its applications”,Mc Graw-Hill Company,INC.

HS2101 ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**2-0-0-0**

Unit –I

Basic Structure Of Indian Knowledge System:

Veda (Ayurveda, Dhanurveda, Gandharva Veda, Sthapatya Aati(Shilpa Veda), Artha Veda, Veedanga (Shiksha, Kalpa, Chhanda, Niruktha, Vyakarana, Jyothishya) Darma Shastra, Mimasha, Purana, Tarkashastra

Unit – II

Modern Science And Indian Knowledge System

Yoga Holistic Health Care

Unit – III

Indian Philosophical Tradition:

A) Orthodox (Hindu) School: Samkya, Yoga, Nyaya, Vaisheshika, Purva Mimamsa, Vedhanta,

B) Hetorodox (Non-Hindu) Schools: Carvaka, Jain, Buddha

Unit-IV

Indian Linguistic Tradition:

Phonology, Morphology, Syntax And Semantics

Unit –V

Indian Artistic Tradition:

Chitra Kala, Mantra Kala, Vaastu Kala, Sangeetha Kala, Nruthyu Evam Sahityam

BS2101 ENVIRONMENTAL SCIENCE

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**3-0-0-0**

UNIT 1:MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, scope and importance, need for public awareness.

UNIT 2: NATURAL RESOURCES:

Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- .Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

UNIT 3: ECOSYSTEMS & BIODIVERSITY

Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystems:-

- Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem, d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).
- Biodiversity- Definition : genetic, species and ecosystem diversity. Biogeographical classification of India Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values.
- Biodiversity at global, National and local levels. Inida as a mega-diversity nation Hot-sports of biodiversity.

- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT 4: ENVIRONMENTAL POLLUTION

Definition, Cause, effects and control measures of :- Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards

13. Solid waste Management: Causes, effect s and control measures of urban and industrial wastes.
14. Role of an individual in prevention of pollution
15. Disaster management: floods, earthquake, cyclone and landslides.
16. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
17. Environment Protection Act., Air (Prevention and Control of Pollution) Act. Water Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act .

UNIT 5 : SOCIAL ISSUES & THE ENVIRONMENT

Human Rights. Value Education. HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health.

Field work : Visit to a local area to document t environmental assets river/ forest/grassland/hill/mountain Visit to a local polluted site-Urban/Rural/Industrial/Agricultural . Study of common plants, insects, birds. Study of simple ecosystems-pond, river, hill slopes, etc.

REFERENCES :

a). Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
b). Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad- 380 013, India, Email:mapin@icenet.net (R)
c). Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
d) Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
e). Cunningham, W.P. Cooper, T.H. Gorhan i, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
f). De A.K., Environmental Chemistry, Wiley Eastern Ltd.
g). Down to Earth, Centre for Science and Environment (R)
h). Gleick, H.P. 1993. Water in Crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p
i). Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R) j) Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.

k). Jadhav, H & Bhosale, V.M. 1995. Environm ental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
l). Mckinney, M.L. & School, R.M. 1996. Environmental Science Systems & Solutions, Web enhanced edition. 639p.
m). Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)
n). Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)
o). Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
p). Rao M N. & Datta, A.K. 1987. Waste Wate r treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.
q). Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut
r). Survey of the Environment, The Hindu (M)
s). Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science.
t). Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R).
u). Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB).
v). Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p
(M) Magazine (R) Reference (TB) Textbook Members of the Expert Committee on Environmental Studies

1. Prof. Erach Bharucha, Director
Bharati Vidyapeeth, Institute of Environment Education & Research, Pune

2. Prof. C. Manoharachary
Department of Botany
Osmania University Hyderabad

3. Prof. S. Thayumanavan
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Anna University, Chennai
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5. Shri R. Mehta
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UGC OFFICIALS
6. Dr. N. K. Jain
Joint Secretary UGC, New Delhi

CY2701 CHEMISTRY LABORATORY

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objectives:

11. To learn the preparation of organic compounds in the laboratory
12. To estimate the hardness and alkalinity of the given sample of water
13. To understand the Job's method for determining the composition
14. Learns how to use the pH meter and polarimeter
15. Synthesis of a pharmacutically active drug

10. Synthesis
6. Synthesis of soap from cheap oil.
7. Synthesis of Thiokol rubber

11. Volumetric analysis
6. Estimation of alkalinity of water
7. Estimation of total hardness of water by EDTA method

12. Job's method
6. Determination of composition of Ferric-Thiocyanate complex by Job's method

13. pH meter
6. Estimation of the strength of a weak acid by pH metry

14. Polarimeter
6. Determination of specific rotation of sucrose by polarimeter

15. Synthesis of Aspirin Drug (NSAID)

Course Outcomes:

Minimum knowledge on basic synthesis, quantitative and qualitative analysis is being imparted

Reference books:

10. College Practical Chemistry by V K Ahluwalia, Sunita Dhingra, Adarsh Gulati
11. Practical Engineering Chemistry by K Mukkanti
12. A Text Book of Engineering Chemistry: by Shashi Chawla
13. Essentials of Experimental Engineering Chemistry by Shashi Chawla
14. Comprehensive Practical Organic Chemistry – Preparation and Quantitative analysis byV K Ahluwalia, Renu Aggarwal

EC2702 ELECTRONIC DEVICES AND CIRCUITS LAB

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-3-1.5**

Section 1: Basics of Electronic Circuits

Section 2: Electronic Device Characteristics

Course Objective:

10. To understand usage of basic electronic equipments like Oscilloscope, Function generator, Multimeter ..etc.
11. To understand the basic electronic components like passive components, active components, bread board, etc.
12. To design the basic circuits by using diodes, zener diode etc.
13. To understand the characteristics of the diodes, Transistors.

Lab 1: Basics of Electronic Circuits

- Familiarization of electrics components and usage of multimeter.
- Familiarization with Oscilloscope and function generator.
- Frequency response and square wave rectifying of RC, CR and RL networks.
- Half wave and full wave rectifiers, Rectification with capacitance filters, Zener diode and IC regulation.
- Study of CE, CB, CC amplifier on kit.

Lab 2: Device Characteristics

- Characteristics of Diodes
  - PN Junction Diode
  - Zener Diode
  - Light Emitting Diode
  - Tunnel Diode
  - Schottky Diode
  - Varactor Diode
- Characteristics of Transistor
  - Bipolar Junction Transistor (Common Base, Common Collector, Common Emitter)
  - Unipolar Junction Transistor (p-channel JFET, n-channel JFET)
  - MOSFET (p-channel enhancement mode MOSFET, n-channel enhancement mode MOSFET, p-channel depletion mode MOSFET, n-channel depletion mode MOSFET)
- Characteristics of Silicon Controlled Rectifier

Course Outcomes: After completion of this lab

10. Students get the ability for usage of basic electronic equipment like Oscilloscope, Function generator, Multimeter ..etc.

11. Students will be having knowledge on the basic electronic components like passive components, active components, bread board, etc.

12. Students can design the basic circuits by using diodes, zener diode etc.

13. Students having the knowledge on characteristics of the diodes, Transistors.

Text /Reference Books:

- Electronic Devices and Circuit Theory – Robert L.Boylestad, Louis Nashelsky, 9th edition, 2008 PE.
- Electronic Devices and Circuits- David A. Bell- 5th Edition, Oxford University Press.
- Jacob Millman, Christos C Halkias and Satyabrata JIT, " Electronics Devices and Circuits", 3rd Edition.
- G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson,2014.
- D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education.
- S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley&Sons, 2006.
- C.T. Sah, "Fundamentals of solid state electronics," World Scientific Publishing Co. Inc, 1991.
- Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

IV SEMESTER

EC2201 ANALOG CIRCUITS (only for ECE)

Externals: 60Marks L-T-P-C Internals: 40Marks 4-0-0-4

Course Objectives:

- The concepts of small signal equivalent circuits of BJT, FET and it's frequency response.
- The concept of multistage amplifiers, differential amplifiers and current mirrors for high input impedance.
- The fundamental concepts of positive and negative feedback and their applications.
- The performance analysis of Operational amplifiers and it's applications.
- The concept of large signal amplifiers and radio frequency amplifiers.

UNIT-I

Diode Applications: Diode Circuits (diode equivalent circuit, clippers, clampers)

Small Signal Analysis: Amplifier models: Voltage amplifier, current amplifier, trans conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

UNIT-II:

High Frequency Analysis: High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier.

Power Amplifiers: Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues.

Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits.

UNIT-III:

Oscillators: Review of the basic concepts, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.

Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage

(VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.

UNIT-IV:

OP-AMP: Introduction of op-amp and its internal circuit diagram. Ideal and practical op-amp with transfer characteristics.

OP-AMP applications: Review of inverting and non-inverting amplifiers, virtual ground concept. Linear op-amps (Adders, Subtractors, V-V, V-I, I-V, I-I amplifiers, Instrumentation amplifier); Non-linear op-amps (Rectifiers, Peak detector, Clipper, Clamper, Logarithmic amplifier) and multipliers; Open loop op-amps (Comparator, Detector); Positive Feedback op-amps (Schmitt trigger, Multivibrators)

Active filters Design: Low pass, high pass, band pass and band stop, design guidelines.

UNIT-V:

Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc.

Analog-to- digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.

Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

Course outcomes:

- An ability to design and analyze the BJT & FET amplifiers at low frequency, mid frequency and high frequency regions.
- An ability to design and perform the cascade amplifiers (i.e. multistage amplifiers) and its frequency response.
- An ability to analyze a given differential amplifier or design a differential amplifier to meet the given specifications with constant current bias circuit.
- An ability to design and analyze the positive feedback and negative feedback amplifiers for a given specifications.
- An ability to design and perform op-amp based circuits and it's applications for a given specifications.
- An ability to understand the large signal amplifiers (i.e. power amplifiers) and its efficiency calculations.
- An ability to understand the waveform generators, timers and analog to digital converters & digital to analog convertors, switched capacitor.

Text Books :

- Electronics Devices and Circuit Theory Boylestad, Robert & Louis, Nashelsky Pearson, 10th Edition
- Microelectronic Circuits-Theory and applications by Adel S. Sedra and Kenneth C.Smith, Fifth Edition , (Oxford International Student Edition)
- Electronic Devices and Circuits- Millman and Halkias, TMH
- Op-Amps and Linear Integrated Circuits Gayakwad , Ramakant A PHI, Learning,4 th Edition Electronic Devices and Circuits Dr. Sharma, Sanjay KATSON,2012

Reference books:

- Fundamentals of Electronic Devices and Circuits David, A Bell Oxford Press, 5thEdition, 2008
- Electronic Principles - with simulation CD Malvino, A.P. Tata McGraw- Hill , Education,7 thEdition
- Basic Electronics and Linear Circuits Bhargava, N.,Kulshreshtha D., S.Gupta Tata McGraw- Hill Education, 2011
- Electronics Devices and Circuits Mottershead, Allen PHI Learning,2011
- Electronic Devices and Circuits- David A Bell - PHI 4th edition

MOOCs:

- https://www.mooc-list.com/course/electronic-systems-and-digitalelectronics-uninettuno?static=true
- http://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-012-microelectronic-devices-and-circuits-spring-2009
- Introductory Analog Electronics Laboratory (Spring 2007) by MIT Open Courseware | Reviews and Ratings

EC2202

CONTROL SYSTEMS

Externals: 60Marks

L-T-P-C

Internals: 40Marks

3-0-0-3

Course Objectives:

11. To familiarize the students with the need for modelling of systems and to represent the system in various ways mathematically.
12. To teach them the various well-established techniques to analyze the stability of systems and related issues.
13. Ability to find time response of given control system model &plot Root Locus and Bode plots for given control system model
14. Ability to design Lead, Lag, Lead-Lag systems in control system & Ability to design PID controllers for given control system model.
15. Ability to learn state space analysis and optimal control system.

UNIT-I: INTRODUCTION

Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of Feedback, Mathematical modeling of physical systems: Differential equation and Transfer functions, Examples of modeling different types (e.g. electrical, mechanical, chemical, biological, social etc.) of systems, Equivalence between the elements of different types of systems. Block diagram algebra –Signal flow graph - Reduction using Mason 's gain formula. Translational and rotational mechanical systems.

UNIT-II*:* TIME DOMAIN ANALYSIS

Standard test signals - Time response of first order systems –Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications. Steady state response - Steady state errors and error constants, Frequency domain response -- Transfer function and its interpretation in terms of frequency responses peak and peaking frequency, bandwidth and cut-off rate; Link between time and frequency domain response features. Advantages of closed loop operation: Sensitivity and complementary sensitivity, Disturbance and noise reduction.

UNIT-III: STABILITY ANALYSIS IN S-DOMAIN

The concept of stability – Routh 's stability criterion – qualitative stability and conditional stability – limitations of Routh 's stability. The root locus concept - construction of root loci- and relative stability using root-locus approach, effects of adding poles and zeros to G(s)H(s) on the root loci.

UNIT-IV: FREQUENCY DOMAIN ANALYSIS

Polar Plots-Nyquist Plots-Stability Analysis. Bode diagrams- Determination of Frequency domain specifications and transfer function from the Bode Diagram-Phase margin and Gain Margin-Stability Analysis from Bode Plots. P, PD, PI, PID Controllers and Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain.

UNIT-V: STATE VARIABEL ANALYSIS

State variable Analysis- Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability. Introduction to Optimal control & Nonlinear control, Optimal Control problem, Regulator problem, Output regulator, treking problem. Nonlinear system – Basic concept & analysis.

Course Outcomes:

At the end of this course students will demonstrate the ability to

5. Characterize a system and find its study state behaviour
6. Investigate stability of a system using different tests
7. Design various controllers
8. Solve liner, non-liner and optimal control problems

Text Books:

8. Automatic Control Systems– by B. C. Kuo and Farid Golnaraghi – John wiley and son's, 8th edition, 2003.
9. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 5th edition, 2007.

Reference Books:

- Modern Control Engineering – by Katsuhiko Ogata – Prentice Hall of India Pvt. Ltd., 5th edition, 2010.
- Control Systems Engineering - by NISE 5th Edition – John wiley.

EC2203

ELECTROMAGNETIC WAVES

Externals: 60Marks

L-T-P-

C Internals: 40Marks

3-0-0-3.

Unit I: INTRODUCTION TO TRANSMISSION LINES:

Concept of distributed elements, equations of voltage and current, standing waves and impedance transformation, lossless and low loss transmission lines, power transfer on a transmission line, short circuit and open circuit lines, parameters of transmission line.

SMITH CHART: applications, applications of transmission line, impedance matching using transmission lines.

Unit II: BASIC LAWS OF ELECTROMAGNETICS:

Gauss's law, Ampere's circuital law, Faraday's law of electromagnetic induction.

Maxwell's equations: Surface charge and Surface current, Displacement current and continuity equation, Boundary conditions at media interface.

Unit III: UNIFORM PLANE WAVES I:

Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity and Poynting vector

Uniform plane waves ii: Plane wave in arbitrary direction, Reflection and refraction of waves at dielectric and conducting interface, Total internal reflection, Brewster angle.

Unit IV: WAVE GUIDES:

Parallel plane wave guide, TE mode, TM mode, TEM mode,

Rectangular wave guides: Group velocity and dispersion, Analysis of rectangular wave guides.

Unit V: ANTENNAS:

Introduction,Radiation parameters of antenna, potential functions and their solutions.

FIELDS: Near and far fields, Radiation resistance and radiation pattern of Hertz dipole, total power radiated by a dipole.

Course Outcomes: At the end of this course students will demonstrate the ability to

8. Understand characteristics and wave propagation on high frequency transmission lines
9. Carryout impedance transformation on TL
10. Use sections of transmission line sections for realizing circuit elements
11. Characterize uniform plane wave
12. Calculate reflection and transmission of waves at media interface
13. Analyze wave propagation on metallic waveguides in modal form
14. Understand principle of radiation and radiation characteristics of an antenna

Text Books:

11. R.K. Shevgaonkar, "Electromagnetic Waves", Tata McGraw Hill, 2005.

12. D. K. Cheng, "Field and Wave Electromagnetics", Addison-Wesley, 1989.

13. M.N.O. Sadiku, "Elements of Electromagnetics", Oxford University press, 2007.

14. C.A. Balanis, "Advanced Engineering Electromagnetics" , John Wiley and sons, 2012.

15. C. A. Balanis, "Antenna Theory: Analysis and Design" , John Wiley and sons,2005

EC2204 PROBABILITY THEORY AND STOCHASTIC PROCESSES

Externals: 60Marks

L-T-P-C Internals: 40Marks

3-1-0-4

Unit I

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Independent events, Combinatorial probability and sampling models.

Unit II

Discrete random variables, probability mass function, probability distribution function, example random variables and distributions;Uniform, Geometric and it's memoryless property, Bernouli, Binomial, Poisson distributions.

Continuous random variables, probability density function, probability distribution function, example distributions; Uniform, Exponential and it's memoryless property, Gaussian distribution, Standard Normal distribution, Q(.) function, Heavy tailed Pareto distribution.

Unit III

Joint distributions, Jointly Gaussian random variables, Marginal distributions, Independent random vatiable, functions of one and two random variables, Sum of random variables, minimum, maximum of random variables, log normal distribution, Rayleigh distribution, Chi-square distribution, Square of Rayleigh random variable, moments of random variables;

Conditional distribution, densities and moments; Mean, Variance, Covariance, Correlation, Correlation coefficient, Covariance Matrix. Uncorrelated random variables. Conditional expectation. Characteristic functions of a random variable; Markov, Chebyshev and Chernoff bounds; Cauchy Schwarz inequality. Use of MATLAB for generating: random Gaussian samples, Rayleigh distributed samples generation using two IID Gaussian samples. Transformation of random variables: Generating Exponential distributed samples using Uniform distributed samples.

Unit IV

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

Unit V

Random process, Stationary processes: Strict sense stationary, Wide sense stationary processes. Gaussian Random process, Mean and covariance functions. Ergodicity. Transmission of random process through LTI. Power spectral density.

Course Outcomes:

At the end of this course students will demonstrate the ability to

v. Understand representation of random signals
vi. Investigate characteristics of random processes
vii. Make use of theorems related to random signals
viii. To understand propagation of random signals in LTI systems.

Text/Reference Books:

viii. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education

ix. A.Papoulis and S. Unnikrishnan Pillai, ``Probability, Random Variables and Stochastic Processes," Fourth Edition, McGraw Hill.

x. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International

xi. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBS Publishers,

xii. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers

xiii. S. Ross, Introduction to Stochastic Models, Harcourt Asia, Academic Press.

CS2205 OBJECT ORIENTED PROGRAMMING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Objectives:

9. The course will introduce standard tools and techniques for software development, using object oriented approach, use of a version control system, an automated build process, an appropriate framework for automated unit and integration tests.
10. To understand Object oriented programming concepts, and apply them in Problem solving.
11. To learn the basics of Java Console and GUI based programming

Detailed Contents:

UNIT-1:

Introduction to OOPS: Paradigms of Programming Languages, Basic concepts of Object Oriented Programming, Differences between Procedure Oriented Programming and Object Oriented Programming, Objects and Classes, Data abstraction and Encapsulation, Inheritance, Polymorphism, benefits of OOP , application of OOPs.

Java :History, Java features, Java Environment, JDK, API.

Introduction to Java :Types of java program, Creating and Executing a Java program, Java Tokens, Keywords, Character set, Identifiers, Literals, Separator, Java Virtual Machine (JVM), Command Line Arguments, Comments in Java program.

UNIT -2:

Elements: Constants, Variables, Data types, Scope of variables, Type casting, Operators: Arithmetic, Logical, Bit wise operator, Increment and Decrement, Relational, Assignment, Conditional, Special operator, Expressions – Evaluation of Expressions

Decision making and Branching: Simple if statement, if, else statement, Nesting if, else, else if Ladder, switch statement, Decision making and Looping: While loop, do-While loop, for loop, break, labelled loop, continue Statement, Simple programs

Arrays: One Dimensional Array, Creating an array, Array processing, Multidimensional Array, Vectors, Wrapper classes, Simple programs

UNIT-3:

Strings: Exploring String class, String Class Methods, String Buffer Class, Simple programs

Class and objects: Defining a class, Methods, Creating objects, Accessing class members, Constructors, Static members, Nesting of Methods, this keyword, Command line input.

Polymorphism – Static Polymorphism, Dynamic Polymorphism, Method overloading, Polymorphism with Static

Methods, Private Methods and Final Methods.

Inheritance: Defining a sub class, Deriving a sub class, Single Inheritance, Multilevel Inheritance, Hierarchical Inheritance, Overriding methods, Final variables and methods, Final classes, Finalizer methods, Abstract methods and classes, Visibility Control: Public access, Private access, default and protected. Abstract classes.

Interfaces - Interfaces vs Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interfaces. Inner classes - uses of inner classes, local inner classes, anonymous inner classes, static inner classes, examples.

UNIT- 4:

Packages: Java API Packages, System Packages, Naming Conventions, Creating & Accessing a Package, Adding Class to a Package, Hiding Classes, Programs

Exception Handling: Limitations of Error handling, Advantages of Exception Handling, Types of Errors, Basics of Exception Handling, try blocks, throwing an exception, catching an exception, finally statement

Multi threading: Creating Threads, Life of a Thread, Defining & Running Thread, Thread Methods, Thread Priority, Synchronization, Implementing runnable interface, Thread scheduling.

I/O Streams: File, Streams, Advantages, The stream classes, Byte streams, Character streams.

JDBC, ODBC Drivers, JDBC ODBC Bridges, Seven Steps to JDBC, Importing java SQL Packages, Loading & Registering the drivers, Establishing connection. Creating & Executing the statement.

UNIT-5:

AWT Components and Event Handlers: Abstract window tool kit, Event Handlers, Event Listeners, AWT Controls and Event Handling: Labels, TextComponent, ActionEvent, Buttons, CheckBoxes, ItemEvent, Choice, Scrollbars, Layout Managers- Input Events, Menus, Programs

Design patterns - Introduction to Creational design patterns, Structural design patterns and Behavioral design patterns.

GUI Programming with Java - Introduction to Swing, limitations of AWT, Swing vs AWT, MVC architecture, Hierarchy for Swing components, Containers - JFrame, JApplet, JDialog, Jpanel. Overview of some swing components Jbutton, JLabel, JTextField, JtextArea, simple swingapplications.

TEXT BOOKS:

1. Java the complete reference, 7 th edition, Herbert Schildt, TMH.

2. Understanding OOP with Java, updated edition, T. Budd, Pearson Education.

REFERENCE BOOKS:

1. An Introduction to programming and OO Design using Java, J.Nino and F.A.

Hosch, John wiley & Sons.

2. Introduction to Java Programming, Y. Daniel Liang, Pearson Education

3. An Introduction to Java programming and Object Oriented Application

Development, R.A. Johnson-Thomson

4. Programming with Java - E. Balagurusamy

5. Object oriented Programming in Java - Dr. G.Thampi

6. Let us Java – Yashavant Kanetkar - BPB Publications, New Delhi - First Edition

2012

7. Core Java, An Integrated Approach, Dr. R. Nageswara Rao

8. An Introduction to Oops with Java - C Thomas WU - TataMc-Graw Hill, New

Delhi - 4th Edition

9. Object oriented Programming through Java - ISRD Group - TataMc-Graw Hill,

New Delhi - Eight Reprint 2011

Outcomes:

After taking the course, students will be able to:

9. Specify simple abstract data types and design implementations, using abstraction functions to document them.
10. Recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
11. Name and apply some common object-oriented design patterns and give examples of their use.

Design applications with an event-driven graphical user interface.

EC2902 ELECTRONICS MINI PROJECT-II

L-T-P-C

0-0-2-1

Topics:

a. Need to implement any hardware for specific application by using analog, digital components and also

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BM0007 MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

Course Objective:

- Enable the students to learn managerial economics principles applied in industries and equip them to handle the tasks in their career by making a real sense of what is happening economically in the organization.
- The course describes the Nature and Scope of Managerial Economics. It gives complete study on the demand and elasticity of demand and methods of demand forecasting.
- It provides a detailed structure on the pricing strategies and shows clear picture methods and sources of raising finance.
- It gives clear cut information of preparing final accounts and capital Budgeting techniques.

Course Outcome:

After the successful completion of this course, the learner will be able to know:

11. The dynamic game of demand and supply, and how the trinity of Economics i.e. Demand, Supply and Scarcity make the things move around the globe.
12. Principles of Microeconomics applied to industries.
13. Concept of forecasting and applying forecasting techniques to address the challenges and opportunities in the organization they work.
14. Cost and Production analysis, Break-Even analysis, Opportunity Cost, how to optimize organizational resources and how to minimize cost and maximize production, revenue and profit
15. Different pricing structure and discount mechanism suitable for business firms.
16. Market structure and how to exploit market structure for optimizing the benefits of organization.
17. Capital requirements and sources of capital.

UNIT I: Introduction to Managerial Economics:

Definition, Nature and Scope of Managerial Ec
Determinants, Law of Demand and its exceptions.
Significance of Elasticity of Demand. Demand Fo
forecasting, methods of demand forecasting.

UNIT II: Theory of Production and Cost Analysis:

Production Function - Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs. Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale. Cost Analysis: Cost concepts, Opportunity cost. Fixed vs. Variable costs, Explicit costs Vs. Implicit costs. Out of pocket costs vs. Imputed costs. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems)- Managerial Significance and limitations of BEA.

UNIT III: Markets & Pricing Policies:

Market structures: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. Objectives and Policies of Pricing- Methods of Pricing: Cost Plus Pricing. Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing.

UNIT IV: Introduction to Financial Accounting: Introduction to Financial Accounting: Double entry Book Keeping, Journal, Ledger, Trail Balance and Final Accounts (Trading account, Profit and Loss Account and Balance sheet with simple adjustments).

UNIT V: Capital and Capital Budgeting:

Capital and Capital Budgeting: Capital and its significance. Types of Capital. Estimation of Fixed and Working capital requirements. Methods and sources of raising finance. Nature and scope of capital budgeting, features of capital budgeting proposals. Methods of Capital Budgeting: Payback Method. Accounting Rate of Return (ARR) and Net Present Value Method, Internal Rate of Return (IRR).

Reference Books:

11. Aryasri: Managerial Economics and Financial Analysis, TMH,2009.
12. Varshney &Maheswari : Managerial Economics, Sulthan Chand,2009.
13. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis, Scitech. 2009.
14. V.Rajasekarn &R.Lalitha. Financial Accounting, Pearson Education. New Delhi. 2010
15. Suma Damodaran, Managerial Economics, Oxford University Press. 2009.

BM10005

CONSTITUTION OF INDIA

Externals: 60Marks **L-T-P-C** **Internals: 40Marks**

2-0-0-0

Constitution of India

8. Mandatory Courses (non-credit)

8.1 Constitution of India – Basic features and fundamental principles

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of

the Constitution. The Parliament of India has been empowered to amend the

Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme

Court of India in its historical judgments. The Constitution of India reflects the idea of

"Constitutionalism" – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India’s legacy of “diversity”. It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be “static” and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950.

The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it “as one of the strongest court in the world”.

Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19

15. Scope of the Right to Life and Personal Liberty under Article 21

EC2801 ANALOG CIRCUITS LAB (only for ECE)

Externals: 60Marks L-T-P-C Internals: 40Marks 0-0-2-1

Course Objectives

11. To design and Characterize of small signal equivalent circuits of BJT, FET and its frequency response.
12. To design differential amplifiers & differential amplifier with active load and its frequency response.
13. To design of simple current mirror circuit using BJT and MOSFET.
14. To design of cascode current mirror circuit using BJT and MOSFET.
15. To design the positive feedback amplifiers for a given specifications and tuned amplifiers & timers.

List of Experiments:

SECTION-A

17. Clipping and Clamping circuits.
18. LC, CLC filters
19. Voltage Regulators.
20. RC-coupled amplifier (single stage & two-stage).
21. Darlington Emitter follower & Tuned voltage amplifier.
22. Power amplifiers (Class-B push pull power amplifier).
23. Feedback amplifiers:
    - v. Voltage series feedback amplifier
    - vi. Voltage shunt feedback amplifier
    - vii. Current shunt feedback amplifier
    - viii. Current series feedback amplifier
24. Oscillators:
    - v. RC-phase shift oscillator
    - vi. Wein-bridge oscillator
    - vii. Hartley oscillator
    - viii. Colpits oscillator

SECTION-B

Operational Amplifiers

- Parameters of Operational Amplifiers.
    - Input bias current, Input Offset current, Input Offset voltage
    - Common Mode Rejection Ratio (CMRR)
- Applications of Operational Amplifiers.
    - v. Inverting op-amp & Non-Inverting op-amp
    - vi. Voltage follower, Summing amplifier
    - vii. ZCD, Schmitt trigger
    - viii. Full wave precision rectifier etc.
- Wave form generators by using op-amp
    - iii. Monostable Multi vibrator
    - iv. Astable Multi vibrator

Data Converters

- Digital to Analog converters.
    - iii. Weighted Resistor Type D/A converter
    - iv. R-2R ladder Type D/A converter
- Analog to Digital converter.
    - 3. Single slope & Dual slope A/D converters
    - 4. Flash type & Successive Approximation Type A/D converters
- Switched capacitor circuit.

Course Outcomes:

8. An ability to design and Characterize of small signal equivalent circuits of BJT, FET and its frequency response.
9. An ability to design differential amplifiers & differential amplifier with active load and it's frequency response.
10. An ability to design of simple current mirror circuit using BJT and MOSFET.
11. An ability to design of cascode current mirror circuit using BJT and MOSFET.
12. An ability to design the positive and negative feedback amplifiers for a given specifications and tuned amplifiers & timers.

Text Books for AC Lab:

12. Electronics Devices and Circuit Theory Boylestad, Robert & Louis, Nashelsky Pearson, 10th Edition
13. Microelectronic Circuits-Theory and applications by Adel S. Sedra and Kenneth C.Smith, Fifth Edition , (Oxford International Student Edition)
14. Electronic Devices and Circuits- Millman and Halkias, TMH
15. Op-Amps and Linear Integrated Circuits Gayakwad , Ramakant A PHI, Learning,4 th Edition Electronic Devices and Circuits Dr. Sharma, Sanjay KATSON,2012

Reference Books for AC Lab:

11. Fundamentals of Electronic Devices and Circuits David, A Bell Oxford Press, 5thEdition, 2008
12. Electronic Principles - with simulation CD Malvino, A.P. Tata McGraw- Hill , Education,7 thEdition
13. Basic Electronics and Linear Circuits Bhargava, N.,Kulshreshtha D., S.Gupta Tata McGraw- Hill Education, 2011
14. Electronics Devices and Circuits Mottershead, Allen PHI Learning,2011
15. Electronic Devices and Circuits- David A Bell - PHI 4th edition

MOOCs for AC lab:

9. https://www.mooc-list.com/course/electronic-systems-and-digitalelectronics-uninettuno?static=true
10. http://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-012-microelectronic-devices-and-circuits-spring-2009/
11. Introductory Analog Electronics Laboratory (Spring 2007) by MIT Open Courseware | Reviews and Ratings.

CS2804 OBJECT ORIENTED PROGRAMMING LAB

Externals: 60Marks

L-T-P-C Internals: 40Marks

0-0-2-1

OBJECTIVES:

7. To model a object oriented programming using abstract data types, encapsulation, inheritance and polymorphism
8. Practical exposure in Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
9. How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.
10. How to test, document and prepare a professional looking package for each business project using javadoc.

Detailed Contents:

Week-I

1. Write a Java program print “Hello World”

2. Write a Java program that prints all real and imaginary solutions to the quadratic equation

ax2 + bx + c = 0. Read in a, b, c and use the quadratic formula

3. Write a Java program to implement calculator operations

4. Write a java program to find prime factors of given number

5. Write a java program to find whether given number is Palindrome or not

6. Write an application that declares 5 integers, determines and prints the largest and smallest in the group.

Week-II

1. Write a Java program to sort given list of numbers.

2. Write a Java program to implement linear search.

3. Write a Java program to implement binary search.

4. Write a java program to add two given matrices.

5. Write a java program to multiply two given matrices.

6. Write a java program for sorting a given list of names.

7. Write a Java program to give an example for command line arguments.

Week-III

1. Write a program to display details of the required employee based on his Id. The details of employee includes, Emp_name, Emp_age, Emp_gender, Emp_designation, Emp_salary, Emp_Address etc.,

2. A mail-order house sells five products whose retail prices are as follows : Product 1 : Rs. 99.90 , Product 2 : Rs. 20.20 , Product 3 : Rs. 6.87 , Product 4 : Rs. 45.50 and Product 5 : Rs. 40.49 . Each product has Prdouct_Id, Product_Name, Product_Quantity, Product_Price. Write an application that reads a series of pairs of numbers as follows :

a) product Id

b) quantity sold your program use a switch statement to determine the retail price for each product. it should calculate and display the total retail value of all products sold.

3. Write java program that inputs 5 numbers, each between 10 and 100 inclusive. As each number is read display it only if it’s not a duplicate of any number already read display the complete set of unique values input after the user enters each new value

4. Write a java program : rolling a pair of dices 10 times [each attempt should be delayed by 10000 ms] and count number Successful attempts. successful attempt : If the pair of Dice results in same values.

5. Implement the following case study using OOP concepts in Java. E-Book stall : Every book has Properties which includes : Book _Name, Book_Author, Book_Count ; Every Customer is having properties as : Customer_Id, Customer_Name, Customer_Address and he can buy Books

from E-Book stall. Write a Program which will display the text book name and the remaining count of text books when a customer buys a text book.

Week-IV

1. Write an application that uses String method compareTo to compare two strings defined by the user.

2. Write an application that uses String method equals and equalsIgnoreCase to tests any two string objects for equality.

3. Write an application that uses String method indexOf to determine the total number of occurrences of any given alphabet in a defined text.

4. Write an application that uses String method concat to concatenate two defined strings.

5. Write a Java program to print all vowels in given string and count number of vowels and consonants present in given string

6. Write an application that finds the length of a given string.

7. Write an application that uses String method charAt to reverse the string.

8. Write an application that finds the substring from any given string using substring method and startsWith & endsWith methods.

9. Write an application that changes any given string with uppercase letters, displays it, changes it back to lowercase letters and displays it.

Week-V

1. Write a Java Program to implement Wrapper classes and their methods.

2. Write an application that prompts the user for the radius of a circle and uses a method called circleArea to calculate the area of the circle and uses a method circlePerimeter to calculate the perimeter of the circle.

3. Write a JAVA program for the following
a. Call by value b. Call by object

4. Create a class Account with an instance variable balance (double). It should contain a constructor that initializes the balance, ensure that the initial balance is greater than 0.0. Acct details: Acct_Name, Acct_acctno, Acct_Bal, Acct_Address.

Create two methods namely credit and debit, getBalance. The Credit adds the amount (passed as parameter) to balance and does not return any data. Debit method withdraws money from an Account. GetBalance displays the amount. Ensure that the debit amount does not exceed the Account's balance. In that case the balance should be left unchanged and the method should print a message indicating "Debit amount exceeded account balance".

5. Write Java program for the following

a. Example for this operator and the use of this keyword.

b. Example for super keyword.

c. Example for static variables and methods.

Week-VI

1. Write a Java program to find Area and Circle of different shapes using polymorphism concept

2. Write a Java program which can give example of Method overloading and overriding

3. Write an application to create a super class Employee with information first name & last name and methods getFirstName(), getLastName() derive the sub-classes ContractEmployee and RegularEmployee with the information about department, designation & method displayFullName() , getDepartment(), getDesig() to print the salary and to set department name & designation of the corresponding sub-class objects respectively.

4. Derive sub-classes of ContractEmployee namely HourlyEmployee & WeeklyEmployee with information number of hours & wages per hour, number of weeks& wages per week respectively & method calculateWages() to calculate their monthly salary. Also override getDesig () method depending on the type of contract employee.

5. Write an application to create a super class Vehicle with information vehicle number,insurance number,color and methods getConsumption() displayConsumption(). Derive the sub-classes TwoWheeler and FourWheeler with method maintenance() and average() to print the maintenance And average of vehicle.

6. Extend the above TwoWheeler class with methods getType() and getName() which gives the information about the type and the name of the company.Create sub-classes Geared and NonGeared with method average() to print the average of a geared and non-geared two wheeler.

Week-VII

1. Create an abstract class Shape which calculate the area and volume of 2-d and 3-d shapes with methods getArea() and getVolume(). Reuse this class to calculate the area and volume of square ,circle ,cube and sphere.

2. Create an abstract class Employee with methods getAmount() which displays the amount paid to employee. Reuse this class to calculate the amount to be paid to WeeklyEmployeed and HourlyEmployee according to no. of hours and total hours for HourlyEmployee and no. of weeks and total weeks for WeeklyEmployee.

3. Create an Interface payable with method getAmount ().Calculate the amount to be paid to Invoice and Employee by implementing Interface.

4. Create an Interface Vehicle with method getColor(),getNumber(), getConsumption() calculate the fuel consumed, name and color for TwoWheeler and Four Wheeler By implementing interface Vehicle.

5. Create an Interface Fare with method getAmount() to get the amount paid for fare of travelling. Calculate the fare paid by bus and train implementing interface Fare.

6. Create an Interface StudentFee with method getAmount(),getFirstName(),getLastName() , getAddress(), getContact(). Calculate the

amount paid by the Hostler and NonHostler student by implementing interface Student Fee

Week-VIII

1. Write a Program to create your own package. Package should have more than two classes. write a Program that uses the classes from the package.

2. Create a package named org.shapes. Create some classes in the package representing some common geometric shapes like Square, Triangle, Circle and so on. write a Program that uses the classes from the package.

3. Write a Java program to create package called dept. Create four classes as CSE, ECE, ME and CE add methods in each class which can display subject names of your respect year. access this package classes from main class

4. Write a Calculator program : Include all calculator operations in as classes in a Package "Calculator" and import in to main class.

5. Write a program for the following

a. Example to use interfaces in Packages. b. Example to create sub package in a package.

Week-IX

1. Program for demonstrating the use of throw, throws & finally - Create a class with a main( ) that throws an object of class Exception inside a try block. Give the constructor for Exception a String argument. Catch the exception inside a catch clause and print the String argument. Add a finally clause and print a message to prove you were there.

2. Write a program that shows that the order of the catch blocks is important. If you try to catch a superclass exception type before a subclass type, the compiler should generate errors.

3. Write a program to rethrow an exception – Define methods one() & two(). Method two() should initially throw an exception. Method one() should call two(), catch the exception and rethrow it Call one() from main() and catch the rethrown

4. Exception Handling program for ClassNotFoundException--thrown if a program can not find a class it depends at runtime (i.e., the class's ".class" file cannot be found or was removed from the CLASSPATH).

5. Exception Handling program for NumberFormatException--thrown if a program is attempting to convert a string to a numerical datatype, and the string contains inappropriate characters (i.e. 'z' or 'Q').

6. Create your own exception class using the extends keyword. Write a constructor for this class that takes a String argument and stores it inside the object with a String reference. Write a method that prints out the stored String. Create a try- catch clause to exercise your new exception.

Week-IX

1. Write a program to create MyThread class with run() method and then attach a thread to this MyThread class object.

2. Write a program where the consumr thread checks the data production status [is over or not] for every 10 ms.

3. Write a Program using Threads to simulate a traffic light. The Signal lights should glow after each 10 second, one by one. For example: Firstly Red, then after 10 seconds, red will be put to off and yellow will start glowing and then accordingly green.

4. Write a Program using Threads for the following case study: Movie Theatre To watch a movie the following process is to be followed, at first get the ticket then show the ticket. Assume that N persons are trying to enter the Theatre hall all at once, display their seuence of entry into theater. Note: The person should enter only after getting a ticket and showing it to the boy.

5. Write a Program using Threads for the following case study: Train Reservation system To reserve a berth the following process need to be followed, at first check the number of available berths with the requested berths, if the number of requested berths are less than or equal to availabe berths then allot berth and print ticket or else display no berths are available. Assume that N persons are trying to reserve the berth, display their sequence of reservation status along with the number of available berths. Note : The person can print ticket only if berth is confirmed.

Week-X

1. Write a program for the following a. display a frame with title MyFrame b. draw a horizontal line. c. Draw one line perpendicular to other. One line parallel to other.

2. Create an application to display a circle within rectangle and fill different colors in the circle & rectangle

3. Write an application that displays any string. Choose color from combo box to change the color of this displayed string and choose its size & type respectively from another two combo boxes.

4. Create a GUI with title STUDENT which has labels roll no., name, course, gender, class, address with textboxes for taking input from the user(without any functionality) and checkboxes for selecting the course, radio buttons for selecting gender with appropriate background color.

Week-XI

1. Write a program to create a frame by creating an object to Jframe class and include close button to terminate the application of the frame.

2. Write a program to create a push button , when the button is clicked an image is displayed in the frame.

3. Write a program to create a menu with several menu items.

4. Create an application Form for University Enroll ment with the following Fields.

a. Check box b. Text area c. List box d. Display text e. Push buttons f. Combo box. g. Radio buttons. h. Back ground color

Week-XII

1. Write a program to insert data into Student Table.

2. Write a program to retrieve the data from the table Student.

OUTCOMES:

CO 1: Be able to analyze and design a computer program to solve real world problems based on

object-oriented principles.

CO 2: Be able to write simple GUI interfaces for a computer program to interact with users, and

to understand the event-based GUI handling principles.

CO 3: A competence to design, write, compile, test and execute straightforward programs using

a high level language.

CO 4: Demonstrate the ability to employ various types of selection constructs in a Java program.

Be able to employ a hierarchy of Java classes to provide a solution to a given set of

requirements.

CO 5: Become familiar with the fundamentals and to acquire programming skills in the Java

language.

V SEMESTER

EC3101 ANALOG AND DIGITAL COMMUNICATIONS

Externals: 60Marks

L-T-P-C Internals: 40Marks

3-0-0-3 .

UNIT-I: Analog Communications:
Amplitude Modulation schemes: AM, DSBSC, SSBSC and VSB modulation and demodulation. Angle Modulation schemes: FM and PM, Spectral characteristics of angle modulated signals. Super hetrodyne receivers, Frequency Division Multiplexing.

UNIT-II: Noise in analog communication systems:

Gaussian and White noise characteristics, Noise in Amplitude modulation and Angle modulation systems, and SNR calculations. Pre-emphasis and De-emphasis. Threshold effect in angle modulation.

UNIT-III: Pulse modulation:

Sampling process and Quantization, SQNR, A-law and μ-law companding. PAM, PCM, DPCM, DM, ADM, Time Division Multiplexing.

Digital modulation schemes:

ASK, PSK, FSK, QAM and their constellations.

UNIT-IV: Detection Theory:

Gram-Schmidt Orthogonalization, Optimal detection of signals in the presence of noise: MAP rule, ML rule. Matched filter receiver. BER calculations for PCM, ASK, PSK,FSK, QAM in AWGN channel.

UNIT-V: Information theory and coding:

Entropy, Mutual information, Source coding theorem, Channel coding theorem, Huffman code, Repetition code, Hamming code.

Course Outcomes:

At the end of this course students will demonstrate the ability to

5. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
6. Analyze the behavior of a communication system in presence of noise
7. Investigate pulsed modulation system and analyze their system performance
8. Analyze different digital modulation schemes and can compute the bit error performance

Text Books:

1. Simon Haykin, —Communication Systems, Wiley-India edition, 3 rd edition, 2010
2. B.P. Lathi, & Zhi Ding, —Modern Digital & Analog Communication Systems , Oxford University Press, International 4th edition, 2010.

Reference Books:

1. John G.Proakis& M. Salehi --- Digital Communications, 5th edition, Mc Graw Hill education, 2014.
2. A. Bruce Carlson, & Paul B. Crilly, —Communication Systems – An Introduction to Signals & Noise in Electrical Communication , McGraw-Hill International Edition, 5th Edition, 2010.
3. Herbert Taub & Donald L Schilling, —Principles of Communication Systems , Tata McGraw-Hill, 3rd Edition, 2009.
4. George Kennedy and Bernard Davis, —Electronics & Communication System , TMH, 2004

EC3102 COMPUTER ARCHITECTURE

Externals: 60Marks

L-T-P-C Internals: 40Marks

3-0-0-3.

Unit I: Basic Structure of Computers:

Functional units, software, performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, addressing mode, Assembly language, Stacks, Queues, Subroutines.

Unit II: Information representation:

Number formats. Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats.

Unit III: Control Design:

Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit.

Unit IV: Memory organization:

Device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

Unit V: I/O organization:

Input - Output systems, Interrupt, DMA, Standard I/O interfaces Concept of parallel processing, Pipelining, Forms of parallel processing.

Course Outcomes: At the end of this course students will demonstrate the ability to

11. Learn how computers work
12. Know basic principles of computer's working
13. Analyze the performance of computers
14. Know how computers are designed and built
15. Understand issues affecting modern processors (caches, pipelines etc.)

Text Books:

12. V.Carl Hammacher, "Computer Organisation", Fifth Edition.
13. A.S.Tanenbum, "Structured Computer Organisation", PHI, Third edition
14. Y.Chu, "Computer Organization and Microprogramming", II, Englewood Chiffs, N.J., Prentice Hall Edition
15. M.M.Mano, "Computer System Architecture", Edition
16. C.W.Gear, "Computer Organization and Programming", McGraw Hill, N.V. Edition
17. Hayes J.P, "Computer Architecture and Organization", PHI, Second edition

EC3103 DIGITAL SIGNAL PROCESSING

Externals: 60Marks **L-T-P-C Internals: 40Marks**

3-0-0-3

UNIT I

PART A: Discrete time signals and Systems:

Introduction to DSP, Applications of DSP, Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals;

PART B

Discrete systems attributes, Representation of system with Difference equations and Impulse response calculation, LSI systems, Circular Convolution with examples

UNIT II

PART A: Frequency domain analysis

Review of DTFT, Discrete Fourier Transform (DFT) with Properties, Computation of Linear and circular convolution using DFT, Fast Fourier Transform Algorithm,

PART B

Z transform, ROC, Properties, System description in the frequency domain.

UNIT III

PART A:Digital filters and finite word length effects

Linear Phase filters, Analysis of simple digital filters,Comb filters, all-pass functions, Procedure for stability criteria of discrete systems

PART B:

Effect of finite register length in FIR filter design.

Unit IV

PART A:Digital Filter Structures:

Direct, parallel, cascade, ladder and lattice for Infinite Impulse Response (IIR) filters

PART B

Possible realizations for FIR or Finite Impulse Response filters, including poly phase.

UNIT V

PART A: Design of Digital filters:

Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Lowpass, Bandpass, Bandstop and High pass filters, invariant and bilinear transformations

PART B:

Design of FIR Digital filters: Windowmethod, and frequency response sampling techniques

Course Outcomes:

At the end of this course students will demonstrate the ability to

4. Represent signals mathematically in continuous and discrete time and
5. frequency domain

6. Get the response of an LSI system to different signals
7. Design of different types of digital filters for various applications

Text/Reference Books:

5. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
6. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
7. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
8. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
9. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992
10. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

EC3104 RF AND MICROWAVE ENGINEERING

Externals: 60Marks
L-T-P-C Internals: 40Marks

3-0-0-3

Course Objectives:

- To prepare students to understand basic principle of microwave and its applications.
- To prepare students to understand different microwave components and analyzing different type of junctions used in microwave engineering.
- To teach the students about various microwave solid state devices and their characteristics.
- To understand and gain complete knowledge about RF basic concepts, RF filter design.
- To understand and gain complete knowledge about RF amplifier design.

UNIT-I: Introduction to Microwaves:

History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC.

Mathematical Model of Microwave Transmission: Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

UNIT-II: Analysis of RF and Microwave Transmission Lines:

Coaxial line, Rectangular waveguide, Circular waveguide, Resonator, Strip line, Micro strip line.

Microwave Network Analysis: Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters.

UNIT-III: Passive and Active Microwave Devices:

Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator.

Microwave active components: Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

UNIT-IV: Microwave Design Principles:

Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design.

Microwave Antennas: Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas.

UNIT-V: Microwave Measurements:

Power, Frequency and impedance measurement at microwave frequency, Network Analyser and measurement of scattering parameters, Spectrum Analyser and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of Microwave antenna parameters.

Microwave Systems: Radar, Terrestrial and Satellite Communication, Radio Aidsto Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.

Course Outcomes:

11. Able to calculate cut off frequency, identify possible modes and obtain mode characteristics of Reflex Klystron and Gunn oscillator.
12. understand the principles of operation of waveguide, gyrator, isolator attenuator etc. and obtain scattering matrix for various junctions like E-plane, H plane, Circulator, Direction Coupler.
13. Analyze and deign basic microwave amplifiers, particularly klystrons, magnetron, and RF filters, basic RF oscillator and mixer models.
14. Become proficient with microwave measurement of power, frequency and VSWR, impedance for the analysis and design of circuits.
15. Analyze T-R Module, microwave systems and microwave antennas.

Text Books:

8. Microwave devices and circuits-Samuel Y. Liao, Pearson, 3rd Edition, 2003.
9. Microwave principles-Herbert J.Reich, J.G.Skalnik, P.F.Ordung andH.L.Krauss, CBS publishers and distributors, New Delhi, 2004.

References:

10. Foundations for microwave engineering-R.E.Collin, IEEE press, John Wiley, 2nd edition, 2002.
11. Microwave circuits and passive devices-M.L.Sisodia and G.S.Raghuvanshi,Wiley Eastern Ltd., New age International publishers Ltd., 1995.
12. Microwave engineering passive circuits-Peter A.Rizzi, PHI, 1999.
13. Electronic and Radio Engineering-F.E.Terman, McGraw-Hill, 4th Edition, 1995

EC3105 VLSI ENGINEERING

Externals: 60Marks

L-T-P-

C Internals: 40Marks

3-0-0-3

Course Objectives:

6. To study the MOS transistors with their characteristics succeeded by the fabrication process.
7. Making aware of VLSI design flow and gaining knowledge on its basic micron constraints for a panoramic view of transistors
8. Understanding various subsystem design concepts and its internal schematics.
9. Comparison of various programmable logic devices in terms of applications
10. To understand the need for testing a VLSI chip by applying the Engineering skills to meet the challenges in semiconductor industries.

UNIT I: INTRODUCTION

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS technologies-
Oxidation, Lithography, Diffusion, Ion implantation, Metallization

Basic Electrical Properties of MOS and BiCMOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, gm, gds, figure of merit o; Pass transistor, NMOS Inverter, Various pull ups, CMOS Inverter analysis and design, Bi-CMOS Inverters.

UNIT II: VLSI CIRCUIT DESIGN PROCESSES

VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2 µm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.

UNIT III: GATE LEVEL DESIGN

Logic Gates and Other complex gates, Switch logic, Alternate gate circuits, Basic circuit concepts, Sheet Resistance RS and its concept to MOS, Area Capacitance Units, Calculations – Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-in and fan-out,Choiceoflayers
Data path subsystem : Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters,.

UNIT IV: SEMICONDUCTOR INTEGRATED CIRCUIT DESIGN

Logic Families: characteristics of digital circuit (Fan-in, Fan-out, power dissipation, propagation delay, noise margin, Figure of Merit etc., Saturated logic families: DCTL, RTL, DTL, HTL, TTL, I2L etc., non-saturated logic families: STTL, ECL. PMOS, NMOS, CMOS.

Array Sub Systems: SRAM, DRAM.

UNIT V: CMOS TESTING

CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Chip level
Test Techniques, System-level Test Techniques, Layout Design for improved Testability.

Course Outcomes:

6. Students will be Analyzed with various processing steps involved in IC on monolithic devices followed by understanding MOSFETS electrical properties.
7. Applying the knowledge of layout, stick diagrams, static and switching characteristics of inverters by CMOS technology for designing a sequential circuit.
8. Students will be good at Realizing CMOS as a switch and its technology for designing a combinational circuit by implementing it using transmission gate/PLD's.
9. Students will be knowing the ability to identify, formulate, and analyze by creating an ability to use the techniques, skills and modern EDA tools necessary for design and test of VLSI circuits by keeping aware of contemporary issues.
10. Students will be good at designing VLSI systems by keeping a view on the design for testability concepts.

TEXTBOOKS :

1. Essentials of VLSI circuits and systems – Kamran Eshraghian, EshraghianDougles and A. Pucknell, PHI, 2005 Edition.
2. Principles of CMOS VLSI Design – Weste and Eshraghian, Pearson Education, 1999.

REFERENCES::

6. Chip Design for Submicron VLSI: CMOS Layout & Simulation, – John P. Uyemura, Thomson Learning.
7. Introduction to VLSI Circuits and Systems – John .P. Uyemura, JohnWiley, 2003.
8. Digital Integrated Circuits – John M. Rabaey, PHI, EEE, 1997.
9. Modern VLSI Design – Wayne Wolf, Pearson Education, 3rd Edition, 1997.
10. VLSI Technology – S.M. SZE, 2nd Edition, TMH, 2003.

EC3901

TECHNICAL SEMINAR

L-T-P-C

Total 100 Marks

0-0-2-1

2. Need to present a seminar topic on recent technologies of Electronicsand Communication Engineering

C3701 ANALOG AND DIGITAL COMMUNICATION LAB

Externals: 60Marks

L-T-P-C Internals: 40Marks

0-0-2-1

List of Experiments:

18. Amplitude Modulation and Demodulation
19. DSB-SC Modulation and Demodulation
20. Frequency Modulation
21. Frequency division multiplexing
22. PAM, PWM, PPM
23. Automatic Gain Control circuit
24. Carrier recovery circuit
25. Mixer circuit
26. Verification of Sampling theorem
27. Quantizer design
28. PCM implementation
29. ASK,PSK,FSK,QPSK modulation demodulation
30. Decoding of corrupted repetition code
31. Time division multiplexing
32. Using MATLAB, plot the constellation of BPSK, QPSK, without noise and with AWGN (under different SNR values) and draw the decision boundaries. Observe the symbol errors, bit errors.
33. Using MATLAB monte-carlo simulations, to find the BER versus SNR curves for ASK, BPSK, FSK, QPSK, 16 PSK, 16-QAM with AWGN channel.
34. Using MATLAB program, find the Huffman code for given set of samples.

Course Outcomes:

At the end of this lab course, students will able to learn the following:

7. Basic level circuit design for AM, DSBSC, FM, modulator and demodulators
8. Basic level receiver circuit design for analog receivers
9. Digitization of analog signals
10. Various modulation techniques used for digital signal transmission and BER performance
11. Demonstration of Frequency division multiplexing and Time division multiplexing
12. Source coding and Channel coding demonstration

EC3702 DIGITAL SIGNAL PROCESSING LAB

Externals: 60Marks

L-T-P-C Internals: 40Marks

0-0-2-1

Course Objectives:

- To implement Linear and Circular Convolution
- FFT algorithm using MATLAB.
- To implement FIR and IIR filters
- Design of digital filters using MATLAB.
- To study the architecture of DSP processor
- Implementation of digital filters on DSP Processor.

List of Experiments

23. Experiments on signal processing using MATLAB.

- Basic matrix operations and Generation of test signals.
- Even and odd parts of the given sequence
- Linear Convolution, circular convolution.
- Interpolation and Decimation
- Discrete Fourier Transform(DFT) and Fast Fourier Transform(FFT)
- Filter Analysis and Implementation.
- Analog Filter Design
- IIR filter design: Butter worth, Chebyshev type 1 and 2: LPF, HPF, BPF & BSF filter.
- FIR filter design using different windows
- Adaptive equalizer, LS, MMSE
- Bayesian, ML estimators

24. Experiments on DSK and CCS

- Study of procedure to work in real- time
- Linear Convolution
- Decimation and Interpolation
- Implementation of IIR filters
- Implementation of FIR filter

Course Outcomes:

Students will be able to:

12. Design and analyze the digital filters using MATLAB.
13. Implement FFT algorithms for linear filtering using MATLAB.
14. implement FIR and IIR filters using MATLAB.
15. Design and Implement the digital filters on DSP processor.

References:

- Digital Signal Processing – A Computer Based Approach By Sanjay K. Mitra, Tata McGraw Hill

- Vinay K. Ingle and John G. Proakis, “Digital Signal Processing using MATLAB”, 4/e, Cengage learning, 2011.
- B. Venkataramani and M. Bhaskar,”Digital Signal Processor architecture, programming and application”, 6/e, TMH, 2006.

EC3703 RF AND MICROWAVE ENGINEERING LAB

Externals: 60Marks

L-T-P-C Internals: 40Marks

0-0-2-1

Course Objectives:

12. The goal of this course is to introduce students to the concepts and principles of the advanced microwave engineering.
13. To study the characteristics of RKO and Gunn oscillator.
14. Measurement of frequency and wavelengths would be learnt by the student.
15. VSWR various TEES, MHD and Circulator would be understood by the student.
16. Radiation pattern would be learnt by the student for horn antenna.
17. To study the usage of hand held Vector Network Analyzer, Spectrum Analyzer, Advanced Microwave Integrated Circuits.

List of Experiments:

SECTION-A

- Study of standing wave pattern.
- Measurement of guide wavelength and frequency.
  - By using Frequency meter i.e. Direct Method
  - By using Slotted line method i.e. Indirect Method
- Repeller mode characteristics of Reflex klystron.
- I-V characteristics of Gunn Diode.
- Measurement of VSWR.
  - By using Slotted line method (S<10)
  - By using Double minimum method (S>10)
- Calibration of Crystal detector.
- Calibration of Attenuator (Fixed attenuation i.e. Power Ratio method).
- Measurement of attenuator (Variable attenuation i.e. RF substitution method)

- Measurement of unknown impedance.
  iii. By using Load impedance formula
  iv. By using Smith Chart
- Radiation pattern of horn antenna and parabolic dish antenna.

SECTION-B

Resonant Microwave components

14. Introduction regarding S-parameters (Study Experiment).
15. Characteristics of Magic-Tee with the help of S-matrix and observe the phase difference with the help of CRO.
16. Characteristics of Directional Coupler.
    vii. Directivity
    viii. Isolation
    ix. Insertion loss
    x. Coupling Factor
    xi. S-matrix
    xii. And Prove $P^2 + q^2 = 1$.

Non-Resonant Microwave components

17. Characteristics of Circulator (3-port).
    iii. Find S-matrix
    iv. Find VSWR
18. 4-port Circulator by using two magic tees and one gyrator.
19. Characteristics of Isolator (By using Y-circulator)
    3. Find S-matrix
    4. Find VSWR

.

Course Outcomes:

15. Gain knowledge and understanding of microwave analysis methods.
16. Be able to apply analysis methods to determine circuit properties of passive/active microwave devices.
17. Analyze the characteristics of RKO and Gunn oscillator.
18. Measure the frequency and guided wavelength.
19. Estimate the VSWR for various loads and S-Matrix for various microwave devices.
20. Obtain the horn antenna radiation pattern.

Text Books:

7. Microwave devices and circuits-Samuel Y. Liao, Pearson, 3rd Edition, 2003.
8. Microwave principles-Herbert J.Reich, J.G.Skalnik, P.F.Ordung and H.L.Krauss, CBS publishers and distributors, New Delhi, 2004.
9. Microwave engineering- David M. Pozar, fourth edition, john wiley & Sons Inc. publications.

References:

16. Foundations for microwave engineering-R.E.Collin, IEEE press, John Wiley, 2nd edition, 2002.
17. Microwave circuits and passive devices-M.L.Sisodia and G.S.Raghuvanshi,Wiley Eastern Ltd., New age International publishers Ltd., 1995.
18. Microwave engineering passive circuits-Peter A.Rizzi, PHI, 1999.
19. Electronic and Radio Engineering-F.E.Terman, McGraw-Hill, 4th Edition, 1995.
20. Microwave and Radar engineering- Dr. M. Kulakarni, Umesh publications, fifth edition, 2015

VI SEMESTER

EC3202 MICRO–CONTROLLERS AND INTERFACING

Externals: 60Marks

L-T-P-C Internals: 40Marks

3-0-0-3

Unit 1: Architecture of Microprocessors:

General definitions of mini computers, microprocessors, micro controllers and digital signal processors. CISC Vs RISC and ARM processors, Overview of 8085 microprocessors.

Unit 2: Architecture and Assembly language of 8086:

Architecture, memory segmentation, signals and pins of 8086 microprocessors. Assembly directives, Addressing modes, Description of Instructions and Assembly software programs with algorithms.

Unit 3: Interfacing with 8086:

Interfacing with peripheral ICs like 8255-PPI, 8237-DMA controller, 8259-Programmable Interrupt Controller, Interfacing with key boards, LEDs, LCDs, ADCs, and DACs etc.

Unit 4: Micro-controller 8051:

Overview of the architecture of 8051 microcontroller, Description of Instructions. Assembly directives. Assembly software programs with Algorithms.

Unit 5: Interfacing with 8051:

Interfacing with keyboards, LEDs, 7 segment LEDs, LCDs, Interfacing with ADCs and DACs, stepper motor etc.

Course Outcomes: At the end of this course students will demonstrate the ability to

4. Do assembly language programming.
5. Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc.
6. Develop systems using microcontrollers

Text Books:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.
4. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.

EC3201 DIGITAL SYSTEM DESIGN
Externals: 60Marks **L-T-P-C Internals: 40Marks**

3-0-0-3

UNIT-I:Introduction to Verilog :Evolution of CAD tools,Overview of Design Flow, Modeling Concepts, Modules and Ports, Different Abstractions-Gate level, Dataflow, Behavioral, Tasks and Functions, Useful Modeling Techniques

.

UNIT-II: Advanced Verilog: Timings and Delays, clocking of Flip Flops- effect of Propagation delay by considering timing constraints, clock skew, Global setup and Hold time.

UNIT-III: Basic systems design

Review of FSM- Meelay, Moore Machines, State graphs, State tables, Design of pattern identification, Hardware realizations- Sequential logic, combinational logic and Verilog Modeling, One hot controller-vending machine, Hardware realizations and Verilog Modeling.

UNIT-IV: Sophisticated designs

ASM-components, Meelay ,Moore ASM, Bus Arbiter, Traffic Light Controller, Dice Game, Micro programming techniques-SQDA,SQSA for Dice Game

UNIT-V: CPLD, FPGA architectures – Programmable logic devices –FPGA, configurable blocks- LUT.CPLD, functional blocks -Macro cells, Overview of various CPLD, FPGA's.

Text Books:

9. Verilog HDL: A Guide to Digital Design and Synthesis, Second Edition By Samir Palnitkar
10. Jon F Wakerly, Digital Design: Principles and Practices, Prentice Hall.
11. Digital Systems Engineering - E-bok - William J Dally, John W Poulton

References:

11. IIT Madras –Prof S Srinivasan- Nptel Lectures

12. CPLD, FPGA Families .
13. Design & analyze synchronous sequential logiccircuits
14. william i fletcher an engineering approach to digital design

ECPE1_
PATTERN RECOGNITION
Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

Introduction to pattern recognition with some real world applications, Supervised, unsupervised, Reinforcement learning introduction. Data Pre-processing, Different types of Distance measures and similarity measures. Classification: Bayes Classifier, ML, MAP estimators, Naive Bayes classifier. K-Nearest Neighbor classifier, Support Vector Machines, Kernel Machines, Over-fitting problem, Artificial Neural Networks: Perceptron learning rule, Gradient Descent learning rule. Limitations and where to apply these classification rules. Multi layered perceptron, Back propagation, logic gates using Perceptron, Sigmoid function, Decision trees. Association rules, Apriori algorithm, Rule generation. Clustering, Anomaly Detection, Regression, Dimensionality Reduction techniques: Feature selection, Principle Component analysis, Independent component analysis, Singular Value Decomposition. Evaluating results: Classification metrics, Regression metric, validation, cross- validation.

Course Outcome:

At the end of this course, students will get the ability to
Do preprocessing task and applying suitable classification algorithm for a given classification task.
Apply clustering algorithm for a given data.
Apply regression analysis technique for prediction.
Work with association algorithms.
Represent the data with less number of features.

Reference books:

R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2002.
C.M.Bishop, Neural Networks and Pattern Recognition, Oxford University Press (Indian Edition), 2003.
Pang-Ning Tan, Michael steinbach and Vipin kumar, Introduction to Data mining, Pearson, 2016.
B.Yegnanarayana, Artificial Neural Networks, PHI, 1999.

CS3203

OPERATING SYSTEMS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

OBJECTIVES:

To learn the fundamentals of Operating Systems.

1. To learn the mechanisms of OS to handle processes and threads and their communication

2. To learn the mechanisms involved in memory management in contemporary OS

3. To gain knowledge on distributed operating system concepts that includes architecture,

Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols

4. To know the components and management aspects of concurrency management

Unit 1:

Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS – Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine.

Unit 2:

Processes: Definition, Process Relationship, Different states of a Process, Process State

transitions, Process Control Block (PCB), Context switching

Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of

multithreads,

Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling

criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time;

Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR

Unit 3:

Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion,

Hardware Solution, Strict Alternation, Peterson's Solution, The Producer\

Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing,

Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.

Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock

Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.

Unit 4: Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–

Internal and External fragmentation and Compaction; Paging: Principle of

operation – Page allocation – Hardware support for paging, Protection and sharing,

Disadvantages of paging.

Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality

of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page

Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not

recently used (NRU) and Least Recently used (LRU).

Unit 5: I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O

Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software,

Secondary-Storage Structure: Disk structure, Disk scheduling algorithms

File Management: Concept of File, Access methods, File types, File operation, Directory

structure, File System structure, Allocation methods (contiguous, linked, indexed),

Free-space management (bit vector, linked list, grouping), directory implementation

(linear list, hash table), efficiency and performance.

Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk

reliability, Disk formatting, Boot-block, Bad blocks

Suggested books:

1. Operating System Concepts Essentials, 9th Edition by AviSilberschatz, Peter Galvin,

Greg Gagne, Wiley Asia Student Edition.

2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings,

Prentice Hall of India.

Suggested reference books:

1. Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin

Publishing

2. Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley

3. Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall

of India

4. Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly

and Associates

Outcomes:

1. Create processes and threads.

2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.

3. For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.

4. Design and implement file management system.

5. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part ofa uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

BM0003

OPERATIONS RESEARCH

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

Course Objectives:

To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

Unit I: Linear Models

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

Unit II : Transportation Models And Network Models

Transportation Assignment Models – Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

Unit III : Inventory Models

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

Unit IV : Queueing Models

Queueing models – Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

Unit V: Decision Models

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

Course Outcomes:

Upon completion of this course, the students can able to use the optimization techniques for engineering and Business problems

Text Books:

19. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003. REFERENCES: 1. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
20. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 1990.
21. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
22. Hillier and Libeberman, "Operations Research", Holden Day, 1986
23. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
24. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002

EC3802 MICRO – CONTROLLERS LAB

Externals: 60Marks **L-T-P-C Internals: 40Marks** **0-0-2-1**

List of Experiment:

Familiarization with TITAN II Kit's hardware and usage of Triton IDE along with Flash Magic for dumping the code to the controller by blinking on board LEDs.

- Interface simple seven segment LED display with controller.
- To Display "DEPT OF ECE" on LCD in 8-bit as well as 4-bit mode
- Interface Keyboard and LCD with controller.
- Interface Stepper Motor by controlling its direction and make it spin faster or slower.
- Interface DC motor and control its speed using PWM technique.
- Design, program and implementTraffic Light system using microcontroller. (prefer the design on breadboard)
- Design, program and implement Elevatorsystem using microcontroller.

  (prefer the design on breadboard)
- Interfacing ADC to Microcontroller.
- Interface DAC with Microcontroller and generate multiple waveforms.
- Interface Temperature Sensor to ADC and measure it on LCD with microcontroller.

Course Outcomes:
Upon completion of the course the students will have

- Ability to understand the hardware kits and way of dumping the program in IC.
- Gain the knowledge of various input and display output devices and their interfacing to µc-8051.
- Understanding of various motors and ability to interface with microcontrollers in various modes.
- Ability to design and demonstrate various applications such as traffic light controller and elevator control.
- Understanding the interfacing of ADCs and DACs, and various analog sensors.

EC3801 DIGITAL SYSTEM DESIGN LAB

Externals: 60Marks **L-T-P-C Internals: 40Marks** **0-0-2-1**

Course Objective:

i. Familiarize with VLSI CAD tools like Xilinx14.4 and Mentor Graphics tool.
ii. Gives Basic concepts of Verilog HDL code to write a code for digital circuits.
iii. To have hands on experience to design digital circuits, simulate and synthesis the design with Xilinx 14.4 VLSI CAD tool with timing diagrams and RTL diagrams.
iv. To have hands on experience for transistor level design and simulate it with transient and dc analysis using mentor Graphics tool.
v. FPGA implantation of the Verilog code written in the VLSI CAD tool.

LIST OF EXPERIMENTS:

- Familiarization with Xilinx14.4 tool.
- Simulate and Synthesis of all basis gates.
- Simulate and synthesis of multiplexers, decoders and code converters.
- Simulate and synthesis of all flipflops.
- Simulate and synthesis of Universal shift register.
- Simulate and synthesis of the binary counter, MOD counters.
- FPGA implementation of basic gates and binary counter.
- Familiarization of the mentor Graphic tool for transistor level design.
- Design and synthesis of a CMOS amplifier
- Transient and DC analysis of CMOS inverter.
- Transient, DC and power analysis of the NAND and NOR gates using CMOS implementation.
- Transient, DC and power analysis of the XOR gates using NAND gates cells.
- Transient, DC and power analysis of the 2x1 MUX using NAND gates cell

Course Outcomes:

- Able to write a Verilog HDL code for the digital systems.
- Able to use the VLSI CAD tools to design digital systems and get synthesis the design to get RTL level diagram.
- Able to simulate the digital system to check the functionality with the timing diagrams.
- Able to do transient and dc analysis of the CMOS Inverter, Logic gates and analog circuits.
- Able to do FPGA Implementation of the combinational and sequential circuits.

ECP01 MINI PROJECT

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **0-0-4-2**

ECCV-I
Comprehensive Viva-I
Externals: 100Marks

L-T-P-C

0-0-2-0

ECP02
Summer Internship
Externals: 60Marks
L-T-P-C
Internals: 40Marks
0-0-2-1

VII SEMESTER

EC_ Preferable Signal Processing Stream Elective
Externals: 60Marks
L-T-P-C
Internals: 40Marks
3-0-0-3

EC_ Preferable Communication Stream Elective
Externals: 60Marks
L-T-P-C
Internals: 40Marks
3-0-0-3

EC_ Preferable Embedded Systems Stream Elective
Externals: 60Marks
L-T-P-C
Internals: 40Marks
3-0-0-3

ECP03 Project Stage-I
Externals: 60Marks
L-T-P-C
Internals: 40Marks
0-0-6-3

BM0010 PROFESSIONAL LAW AND ETHICS
Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

Course Objective: To understand the Legal and Regulatory Framework for doing business in India.
Course Outcome: Students will be able to understand a) Business Laws related to contracts b) Importance of Ethics in Business c) IPR and Legal Aspects.

UNIT - I : Business Ethics Definition - Importance of Ethics in Business - Distinction between Values and Ethics - Characteristics of Ethical Organization - Morality and Professional Ethics - Ethical Dilemmas- How to create an ethical working environment-Ethical Decision making in Business- Role ofcorporate Governance in ensuring ethics in workplace - Indian Ethical Traditions.

UNIT – II: ETHICS IN FUNCTIONAL AREAS OF BUSINESS- Ethics in Marketing: Ethical practices in product packaging and labeling - Pricing - Advertising -Direct marketing – Green marketing - Ethical vs. Unethical marketing behavior. Ethics in HRM:Ethical implications of Privacy – Harassment – Discrimination – Whistle blowing. Ethics inFinance: Accountability – Window dressing and disclosure practices – Insider trading.

UNIT –III: Law of Contract: Nature of Contract and Essential elements of valid contract, Offer and Acceptance, Consideration, Capacity to contract and Free Consent, Legality of Object, Performance and discharge of Contracts, Remedies for breach of contract.

Unit-IV
Contracts-II: Indemnity and guarantee, Contract of Agency, Sale of goods Act -1930: General Principles, Conditions & Warranties, Performance of Contract of Sale.

Unit- V: Law relating to Intellectual Property:Introduction – meaning of intellectual property, main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets;

Suggested readings:

1. Maheshwari & Maheswari - A Manual of Business Laws, Himalaya Publishing House.
2. D. Chandra Bose - Business Law PHI-Private Limited, New Delhi.
3. A.C. Fernando - Business Ethics An Indian Perspective Pearson Education 4.Manuel G. Velasquez - Business Ethics Concepts and Cases Prentice-Hall of India Pvt.Ltd, 2008.
5. S.S. Gulshan - Business Laws Excel Books, New Delhi

CS4101 COMPUTER NETWORKS

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

Objectives:

- To Introduce The Fundamental Various Types Of Computer Networks.
- To Demonstrate The TCP/IP And OSI Models With Merits And Demerits.
- To Introduce UDP And TCP Models.

Detailed Contents:

UNIT - I:

Introduction- Hardware And Software, Data Communication, Networking, Protocol, Layering Scenario, TCP/IP Protocol Suite: The OSI Model,Internet History Standards And Administration; Comparioson Of The OSI And TCP/IP Reference Model, Digital And Analog Data And Signals.

Physical Layer: Guided Transmission Media, Wireless Transmission Media.

Data Link Layer: Design Issues, CRC Codes, Elementary Data Link Layer Protocols, SlidingWindow Protocol, Flow Control. Error Detection And Error Control. HDLC And

other Data Link Protocols.

UNIT - II:

Band Width Utilization: Multiplexing – Frequency-Division, Synchronous Time-Division, And Statistical Time-Division Multiplexing.

Multi Access Protocols: ALOHA, CSMA, Collision Free Protocols, Ethernet-Physical Layer,Ethernet Mac Sub Layer, Data Link Layer Switching & Use Of Bridges, Learning Bridges, Spanning Tree Bridges, Repeaters, Hubs, Bridges, Switches, Routers And Gateways.

UNIT-III:

Network Layer: Network Layer Design Issues, Store And Forward Packet Switching ConnectionLess And Connection Oriented Networks-Routing Algorithms-Optimality Principle, Shortest Path, Flooding, Distance Vector Routing, Control To Infinity Problem, Hierarchical Routing, Congestion Control Algorithms, Admission Control.

UNIT-IV:

Internetworking: Tunneling, Internetwork Routing, Packet Fragmentation, Ipv4, Ipv6 Protocol,IP Addresses, CIDR, IMCP, BOOTP, ARP, RARP, DHCP, Network Address Translation(NAT) Internetworking

Transport Layer: TCP Introduction, Reliable/Un- Reliable Transport ,Connection Establishment, Connection Release, Crash Recovery, Intra-Domain Routing: Distance-Vector, Intra-Domain Routing: Link-State, Wireless Networks: 802.11 MAC, Efficiency Considerations

UNIT-V:

The Internet Transport Protocols: UDP-RPC, Real Time Transport Protocols, The InternetTransport Protocols- Introduction To TCP, The TCP Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Connection Management Modeling, The TCP Sliding Window, The TCP Congestion Control, The Future Of TCP.

Application Layer: Introduction, Providing Services, Applications Layer Paradigms, ClientServer Model, Standard Client-Server Application-HTTP, FTP, Electronic Mail, TELNET, DNS, SSH,SNMP,WWW.

Text Books:

1.Computer Networks, by Andrew s Tanenbaum,PHI(2010)

2.Data and Computer Communications,by William Stallings,PHI(2002)

References Books:

- Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.
- Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.
- An Engineering Approach to Computer Networks - S. Keshav, 2nd Edition, Pearson Edication.
- Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.
- Introduction to Computer Networks and Cyber Security, Chwan-Hwa (John) Wu, J. David Irwin, CRC Press.
- Computer Networks, L. L. Peterson and B. S. Davie, 4th edition, ELSEVIER.
- Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.

Course Outcomes:

- Students should understand and explore the basics of Computer Networks and Various Protocols. He/She will be in a position to understand the World Wide Web concepts.
- Students will be in a position to administrate a network and flow of information further he/she can understand easily the concepts of

network security, Mobile and ad hoc networks.

CS4701 COMPUTER NETWORKS LAB

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objectives

- To understand the working principle of various communication protocols.
- To analyze the various routing algorithms.
- To know the concept of data transfer between nodes

Detailed Contents:

Week-1

- Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool.
- Study of Network Devices in Detail.

Week-2

- Study of network IP.
- Connect the computers in Local Area Network.

Week-3

- Study of basic network command and Network configuration commands.

- Socket Program for Echo/Talk commands.

Week-4

- Configure a Network topology using packet tracer software.

Week-5

- Configure Network using Link State Vector Routing protocol.
- Configure a Network using Distance Vector Routing protocol.

Week-6

- Write a program to implement RPC (Remote Procedure Call)
- Write a code simulating PING and TRACEROUTE commands

Week-7

- Implementation of STOP & WAIT protocol and sliding window protocol
- Write a program to implement sub netting and find the subnet masks.

Week-8

- Create a socket for HTTP for web page upload and download.
- Create a socket (UDP)

Week-9

- Using TCP/IP sockets, write a client server program to make client sending the file name and the server to send back the contents of the requested file if present.

Week-10

- Simulation of ARP/RARP

Week-11

- TCP Module Implementation

Week-12

- Applications using TCP and UDP Sockets like d. DNS and SNMP

Course Outcomes:

- Identify and use various networking components Understand different transmission media and design cables for establishing a network
- Implement any topology using network devices
- Analyze performance of various communication protocols.
- Compare routing algorithms
- Understand the TCP/IP configuration for Windows and Linux
- Implement device sharing on network
- Learn the major software and hardware technologies used on computer networks

VIII SEMESTER

EC_ PROGRAM ELECTIVE

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

EC_ OPEN ELECTIVE

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

EC_ OPEN ELECTIVE

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

EC_ OPEN ELECTIVE

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

ECP04 PROJECT STAGE-II

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-16-8**

ECCV-II COMPREHENSIVE VIVA-II

Externals: 100Marks **L-T-P-C**

0-0-2-0

CURRICULUM FOR PROFESSIONAL ELECTIVE SUBJECTS

Credit Distribution for Professional Elective Subjects			
Stream-I			
Sl. No.	Course Code	Course Title	Semester
1	ECPE1_	Digital Image Processing	VII
2	ECPE1_	Adaptive Signal Processing	VII

3	ECPE1_	Biomedical Signal Processing	VII
4	ECPE1_	Pattern Recognition	VII
5	ECPE1_	Digital Image and Video Processing	VII
6	ECPE1_	Speech and Audio Processing	VII
7	ECPE1_	Detection and Estimation Theory	VII
8	ECPE1_	Wavelets	VII
9	ECPE1	Machine Learning Techniques	VII
10	ECPE1	Deep Learning	VII
11	ECPE1	Multimedia Communication	VII
12	ECPE1	DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES	VII
13	ECPE1	Data Mining	VII
Stream-II			
1	ECPE2_	Wireless Communications	VII
2	ECPE2_	Satellite Communication	VII
3	ECPE2_	Wireless Sensor Networks	VII
4	ECPE2_	Large MIMO Systems	VII
5	ECPE2_	Applied Optimization for Wireless, Signal Processing, Machine Learning	VII

6	ECPE2_	Principles of Signal Estimation for MIMO – OFDM Communications	PEC	3	0	0	3	3	VII
7	ECPE2_	Error Correcting Codes	PEC	3	0	0	3	3	VII
8	ECPE2_	Information Theory and Coding	PEC	3	0	0	3	3	VII
9	ECPE2_	Radar Systems	PEC	3	0	0	3	3	VII
10	ECPE2_	Adhoc Wireless Sensor Networks	PEC	3	0	0	3	3	VII
Stream-III			PEC	3	0	0	3	3	
1	ECPE3_	IoT and Applications + (Lab for 1 credit)	PEC	3	0	0	3	3	VII
			PEC	3	0	0	3	3	
2	ECPE3_	Embedded Systems	PEC	3	0	0	3	3	VII
3	ECPE3_	Nano Electronics							VII
4	ECPE3_	Introduction to MEMS	PEC	3	0	0	3	3	VII
5	ECPE3_	Mixed Signal Design							VII
6	ECPE3_	CMOS Design	PEC	3	0	0	3	3	VII
7	ECPE3_	Power Electronics	PEC	3	0	0	3	3	VII
8	ECPE3_	High Speed Electronics	PEC	3	0	0	3	3	VII
9	ECPE3_	Embedded System Design	PEC	3	0	0	3	3	VII
10	ECPE3_	Analog VLSI and Mixed Signal Design	PEC	3	0	0	3	3	VII
11	ECPE3_	CMOS Analog VLSI Design							VII

12	ECPE3_	CMOS Digital VLSI Design	VII	PEC	3	0	0	3	3
13	ECPE3_	REAL TIME OPERATING SYSTEMS	VII	PEC	3	0	0	3	3
14	ECPE3_	CAD for VLSI Circuits	VII	PEC	3	0	0	3	3
15	ECPE3_	RF Integrated Circuits	VII	PEC	3	0	0	3	3
Stream-IV									
1	ECPE4_	Fiber Optic Communication	VIII	PEC	3	0	0	3	3
2	ECPE4_	Antennas and Propagation	VIII	PEC	3	0	0	3	3
3	ECPE4_	Microwave Theory and Techniques	VIII	PEC	3	0	0	3	3
4	ECPE4_	Electronic Measurement and Instrumentation	VIII	PEC	3	0	0	3	3

ECPE1_ DIGITAL IMAGE PROCESSING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

Learn and understand the representation of Two Dimensional Linear shift invariant Systems using Matrices

To understand the acquisition of digital images.

Learn and implement the algorithms for basic image processing applications such as image enhancement

Formulate and solve the optimization problems to achieve image restoration from degraded images

To implement, analyze, and asses the performance of the image processing algorithms.

Unit-I: INTRODUCTION:

Mathematical Preliminaries and Two dimensional Systems

Introduction to image Processing and applications of image processing in different fields, Fundamentals of Linear algebra, and Probability, one dimensional and two dimensional Linear shift invariant systems and their representation using matrices, one dimensional and Two Dimensional Convolution, Separable operations using matrices, Two dimensional Discrete time Fourier transform, Two dimensional Z transform and Properties.

Unit-II: Image sampling and Quantization

Sampling of One dimensional signals, Sampling of Two dimensional signals, Anti-aliasing filter, Quantization: Liyod Max quantizer, Uniform quantizer, Signal to quantization noise ratio.

Unit-III: Image Transforms

Unitary transforms and properties, 1D & 2D Discrete Fourier transform, 1D & 2D Discrete cosine transform, 1D & 2D Discrete sine transform, 1D & 2D Discrete Walsh transform, 1D & 2D Discrete Hadamard transform, 1D & 2D Discrete Haar transform, 1D & 2D Discrete KLT transform, Application of KLT for Face recognition.

Unit-IV: Image Enhancement

Point operations: contrast stretching, digital negative, Power law correction, dynamic range compression, intensity level slicing, Thresholding, Bit plane extraction; Histogram equalization and histogram specification; spatial operations:Linear and non linear filtering in spatial domain using spatial masks, Unsharp masking; Transform Operations: Filtering in transform domain; Psuedo coloring

Unit – V: Image Restoration

Classification of restoration methods, Characteristic metrics for Image restoration, Linear and non linear degradation models, Inverse filtering, Pseudo inverse filtering, Wiener filtering: Least squares approach.

Course Outcomes:

To Introduce the applications of the Digital image processing in different research fields, and learn the Mathematical preliminaries required for analyzing two dimensional systems.

Learn the acquisition process of a Digital images

Demonstrated understanding of Image transforms such as Discrete Fourier Transform, Cosine Transform, Hadamard Transform, and KLT.

Demonstrated understanding of image enhancement techniques

Understanding of formulation and solution of image restoration techniques

REFERENCES:

A.K Jain , Fundamentals of Digital Image Proceessing, Prentice Hall.

R. C. Gonzalez, R.E. Woods, Digital Image Processing, Pearson.

ECPE1_ ADAPTIVE SIGNAL PROCESSING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

General concept of adaptive filtering and estimation, applications and motivation, Review of probability, random variables and stationary random processes, Correlation structures, properties of correlation matrices.

Unit II:

Optimal FIR (Wiener) filter, Method of steepest descent, extension to complexvalued The LMS algorithm (real, complex), convergence analysis, weight errorcorrelation matrix, excess mean square error and mis-adjustment

Unit III:

Variants of the LMS algorithm: the sign LMS family, normalized LMSalgorithm, block LMS and FFT based realization, frequency domain adaptive filters, Sub-band adaptive filtering. Signal space concepts - introduction to finite dimensional vectorspace theory, subspace, basis, dimension, linear operators, rank and nullity, inner product space, orthogonality, GramSchmidt orthogonalization, concepts of orthogonal projection,orthogonal decomposition of vector spaces.

Unit IV:

Vector space of random variables, correlation as inner product, forward andbackward projections, Stochastic lattice filters, recursive updating of forward and backward prediction errors, relationship with AR modeling, joint process estimator, gradient adaptive lattice.

Unit V:

Introduction to recursive least squares (RLS), vector space formulation of RLSestimation, pseudo-inverse of a matrix, time updating of inner products, development of RLS lattice filters, RLS transversal adaptive filters. Advanced topics: affine projection and subspace based adaptive filters, partial update algorithms, QR decomposition and systolic array.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand the non-linear control and the need and significance of changing the control parameters w.r.t. real-time situation.

Mathematically represent the ‘adaptability requirement’.

Understand the mathematical treatment for the modeling and design of the signal processing systems.

Text/Reference Books:

S. Haykin, Adaptive filter theory, Prentice Hall, 1986.

C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

EC4435 BIOMEDICAL SIGNAL PROCESSING

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Outcomes:

1. To understand the origin, acqusition and processing of Bio signals and their application for diagnosis, and different Imaging modalities

2. To understand the cardiac and brain signal processing for various applications

3. To learn fundamentals of digital images, and 2 D systems, and various image transforms

4. To learn image enhancement and image restoration methods

5. To learn different classification techniques

Chapter 1:Introduction to bio Signals and Bio images

The Nature of Biomedical SignalsExamples of Biomedical Signals,Origin of bio potenials, The action potential of a cardiac myocyte,The action potential of a neuron,The electroneurogram (ENG),The electromyogram (EMG),The electrocardiogram (ECG).The electroencephalogram (EEG),Event-related potentials (ERPs),The electrogastrogram

(EGG),The phonocardiogram (PCG),The carotid pulse,Signals from catheter-tip sensors,The speech signal,The vibromyogram (VMG),The vibroarthrogram (VAG),Otoacoustic emission (OAE) signals,Bioacoustic signals. Biomedical images: Different imaging modalities, Computer aided Tomography

Chapter 2: Cardiac and Brain signal Processing

Acqusition of ECG: Standard 12 lead system, ambugulatory ECG signal, Fundamental Prolems of Cardiac signal Processing, Pre processing techniques, QRS detection: Categorisation, Pam Tompkins technique, Automatic heart beat classification, AAMI standard, Review of methods of heart beat classification,

Chapter 3:

Digital image acquisition, sampling and quantization, Response of 1D LSI system for non-periodic and periodic inputs (Using matrix method), Response of Two dimensional LSI systems for non periodic and periodic inputs using row ordered vector form of images, Image transforms: Unitary transforms and properties, Discrete Fourier transform, Discrete Cosine transform, Discrete sine transform, Walsh transform, Hadmard transform, Haar transform, KL transform

Chapter 4:

Image enhancement: Point processing techniques: Contrast stretching, dynamic range compression, Power law correction, Bit plane slicing, Gray level slicing, thresholding, Hisogram equalization, Histogram matching, Neighbour hood processing: LSI filtering, Low pass filters, High pass filters: First order and second order derivative filtes, High boost filtering, Frequency domain processing

Image Restoration: Difference between Image restoration and Image enhancement, Performance metrics, Simplifies model for degradation using LSI approximation, methods of estimation of degradation function, Models for different degradations, Inverse filtering, effect of noise on inverse filtering: Least sqaures filtering, Constrained Least squares filtering, Weiner filtering

Chapter 5:

Data preprocessing, Feature extraction methods, Regression, Classification: Supervised and Unsupervised learning, Nearest neighbour classification, Bayesian classifier, K Nearest neighbour classification, Support vector machine, Artifical neural networks, K means clustering,

Reference Books:

1. “BIOMEDICAL SIGNAL ANALYSIS”, RANGARAJ M. RANGAYYAN, IEEE press, Wiley

2. “Fundamentals of Digital image processing” by A.K Jain, PhI

3. “Digital image processing”, R. Gonzalez and Woods

ECPE1_ PATTERN RECOGNITION
Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Introduction to pattern recognition with some real world applications, Supervised, unsupervised, Reinforcement learning introduction. Data Pre-processing, Different types of Distance measures and similarity measures. Classification: Bayes Classifier, ML, MAP estimators, Naive Bayes classifier. K-Nearest Neighbor classifier, Support Vector Machines, Kernel Machines, Over-fitting problem, Artificial Neural Networks: Perceptron learning rule, Gradient Descent learning rule. Limitations and where to apply these classification rules. Multi layered perceptron, Back propagation, logic gates using Perceptron, Sigmoid function, Decision trees. Association rules, Apriori algorithm, Rule generation. Clustering, Anomaly Detection, Regression, Dimensionality Reduction techniques: Feature selection, Principle Component analysis, Independent component analysis, Singular Value Decomposition. Evaluating results: Classification metrics, Regression metric, validation, cross- validation.

Course Outcome:

At the end of this course, students will get the ability to
Do preprocessing task and applying suitable classification algorithm for a given classification task.
Apply clustering algorithm for a given data.
Apply regression analysis technique for prediction.
Work with association algorithms.
Represent the data with less number of features.

Reference books:

R.O.Duda, P.E.Hart and D.G.Stork, Pattern Classification, John Wiley, 2002.
C.M.Bishop, Neural Networks and Pattern Recognition, Oxford University Press (Indian Edition), 2003.
Pang-Ning Tan, Michael steinbach and Vipin kumar, Introduction to Data mining, Pearson, 2016.
B.Yegnanarayana, Artificial Neural Networks, PHI, 1999.

ECPE1_ DIGITAL IMAGE AND VIDEO PROCESSING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Digital Image Fundamentals-Elements of visual perception, image sensing andacquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Unit II:

Image Enhancements and Filtering-Gray level transformations, histogramequalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Unit III:

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations–formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Image Segmentation- Detection of discontinuities, edge linking and boundarydetection, thresholding – global and adaptive, region-based segmentation.

Unit IV:

Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

Unit V:

Image Compression-Redundancy–inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards – JPEG and JPEG-2000.

Fundamentals of Video Coding- Inter-frame redundancy, motion estimationtechniques – fullsearch, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy – Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation- Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation – motion-based; Video object detection and tracking.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Mathematically represent the various types of images and analyze them.

Process these images for the enhancement of certain properties or for optimized use of the resources.

Develop algorithms for image compression and coding

Text/Reference Books:

R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008

Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004

Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

ECPE1_ SPEECH AND AUDIO PROCESSING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Introduction- Speech production and modeling - Human Auditory System;General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid ; Requirements of speech codecs –quality, coding delays, robustness. Speech Signal Processing- Pitch-period estimation, all-pole and all-zero filters,convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

Unit II:

Linear Prediction of Speech- Basic concepts of linear prediction; LinearPrediction Analysis of non-stationary signals – prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

Unit III:

Speech Quantization- Scalar quantization– uniform quantizer, optimum quantizer,logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization – distortion measures, codebook design, codebook types.

Scalar Quantization of LPC- Spectral distortion measures, Quantization based onreflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

Unit IV:

Linear Prediction Coding- LPC model of speech production; Structures of LPCencoders and decoders; Voicing detection; Limitations of the LPC model.

Unit V:

Code Excited Linear Prediction-CELP speech production model; Analysis-by-synthesis; Generic CELP encoders and decoders; Excitation codebook search – state-save method, zero-input zerostate method; CELP based on adaptive codebook, Adaptive Codebook search; Low Delay CELP and algebraic CELP.

Speech Coding Standards-An overview of ITU-T G.726, G.728 and G.729standards

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Mathematically model the speech signal

Analyze the quality and properties of speech signal.

Modify and enhance the speech and audio signals.

Text/Reference Books:

"Digital Speech" by A.M.Kondoz, Second Edition (Wiley Students Edition), 2004.

"Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

ECPE1_ DETECTION AND ESTIMATION THEORY

Externals: 60Marks

L-T-P-C

Internals: 40Marks

3-0-0-3

Course Objectives:

To enable the students to acquire the fundamental concepts of Signal detection and estimation
To expose the conceptual basics of Hypotheses.
To introduce the methods of Detection and estimation of signals in white and non-white Gaussian noise.
To familiarize with the detection of random signals.
To enable the students to understand the time varying waveform detection and its estimation.

UNIT –I: Random Processes

Discrete Linear Models, Markov Sequences and Processes, Point Processes,and Gaussian Processes.

UNIT –II: Detection Theory

Basic Detection Problem, Maximum A posteriori Decision Rule,Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)-minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

UNIT –III: Linear Minimum Mean-Square Error Filtering

Linear Minimum Mean Squared Error stimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with tored Data, Real-time Digital Wiener Filters, Kalman Filters.

UNIT –IV: Statistics

Measurements, Nonparametric Estimators of Probability Distribution and DensityFunctions,Point Estimators of Parameters, Measures of the Quality of Estimators, Introductionto Interval stimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression,Multiple Linear Regression.

UNIT –V: Estimating the Parameters of Random Processes from Data

Tests for Stationarity andErgodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Special Density Functions.

TEXT BOOKS:

Random Signals: Detection, Estimation and Data Analysis - K. Sam

Shanmugan&A.M.Breipohl, Wiley India Pvt. Ltd, 2011.

Random Processes: Filtering, Estimation and Detection - Lonnie C. Ludeman, Wiley India Pvt. Ltd., 2010.

REFERENCES:

Fundamentals of Statistical Signal Processing: Volume I Estimation Theory– Steven.M.Kay,Prentice Hall, USA, 1998.

Fundamentals of Statistical Signal Processing: Volume I Detection Theory– Steven.M.Kay,Prentice Hall, USA, 1998.

Introduction to Statistical Signal Processing with Applications - Srinath, Rajasekaran,Viswanathan, 2003, PHI.

ECPE1_ WAVELETS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Introduction to time frequency analysis; the how, what and why about wavelets, Short-time Fourier transform, Wigner-Ville transform.;Continuous time wavelet transform, Discrete wavelet transform, tiling of the time-frequency plane and wave packet analysis, Construction of wavelets. Multiresolution analysis. Introduction to frames and biorthogonal wavelets, Multirate signal processing and filter bank theory, Application of wavelet theory to signal denoising, image and video compression, multi-tone digital communication, transient detection.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand time-frequency nature of the signals.

Apply the concept of wavelets to practical problems.

Mathematically analyze the systems or process the signals using appropriate wavelet functions.

Text/Reference Books:

Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.

I. Daubechies, Ten Lectures on Wavelets, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1992.

C. K. Chui, An Introduction to Wavelets, Academic Press Inc., New York, 1992.

Gerald Kaiser, A Friendly Guide to Wavelets, Birkhauser, New York, 1995.

P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.

A.N. Akansu and R.A. Haddad, Multiresolution signal Decomposition: Transforms, Subbands and Wavelets, Academic Press, Oranld, Florida, 1992.

B.Boashash, Time-Frequency signal analysis, In S.Haykin, (editor), Advanced Spectral Analysis, pages 418--517. Prentice Hall, New Jersey, 1991.

EC4503 MACHINE LEARNING TECHNIQUES 4L-0-0-3 (3 credits)

Course Objectives:

- To introduce students to the basic concepts and classical techniques of Machine Learning.
- To study optimization algorithms used in Machine learning.
- To study various classification techniques, regression, clustering, ANN.
- To study Deep learning concepts: CNN, RNN and hyper parameter tuning, some case studies.

<u>UNIT-1</u>(Introduction):

Introduction to Machine Learning: Supervised learning, Unsupervised learning, Reinforcement learning. Machine Learning applied to AI examples. Structured data, Unstructured data, training data, test data, cross validation, data collection (Unbiased data), data cleaning, feature extraction, Properties of best features for classification. Linear Regression, Logistic Regression. Over fitting problem. Bias-Variance tradeoff.

<u>UNIT-2</u>(Classical Techniques of ML):

Error metrics, error metrics for skewed classes, Gradient Descent algorithms: Batch, mini-batch, Stochastic Gradient descent.

Classification Techniques: Bayes classifier, Naïve Bayes classifier, K-Nearest neighbor, Perceptron learning algorithm, Multi-layer Perceptron, Regularization, Support Vector Machines, Decision tree algorithm.
Clustering: K-means clustering
Dimensionality Reduction, Anomaly detection.

UNIT-3(Artificial Neural Networks):

Introduction to Neural networks, back propagation algorithm. Activation functions: Sigmoid, tanh, ReLU, SoftMax.Regularization techniques.

UNIT-4(CNN)

Deep learning, vanishing gradients problem, Hyper parameters.
CNN and applications to Computer Vision.
Hyper parameters tuning.
Case studies: LeNet-5, AlexNet, VGG-16, ResNets
Self-driving car application.
Generative Adversial Networks (GAN)

UNIT-5(RNN)

RNN and application to sequence modeling. Hyper parameters tuning.

Some Case studies.

Course Outcomes:

At the end of the course, students will learn the various algorithms related to Supervised Learning, Unsupervised learning, Deep learning concepts.

Text Books:

1. Deep Learning, Goodfellow et al, MIT Press

2. and Machine Learning, Christopher Bishop, Springer

Reference MOOCs:

- “Machine Learning” by Prof.Andrew NG, Coursera (Stanford)
- “Deep Learning” by Prof.Andrew NG, Coursera (Stanford)

EC4432 MULTIMEDIA COMMUNICATION
Externals: 60Marks

(L-T)-P-C

Internals: 40Marks

4-0-3

Course Objectives

- The course is designed
- To provide an introduction to the fundamental principles and techniques in Multimedia Signal coding and compression.
- To give an overview of current multimedia standards and technologies.
- To provide techniques related to computer and multimedia networks.
- To provide knowledge related to Multimedia Network Communications and Applications.

Course Outcomes

- Upon completing the course, the student will be able to:
- Understand the fundamentals behind multimedia signal processing.
- Understand the fundamentals behind multimedia compression.
- Understand the basic principles behind existing multimedia compression and communication standards.
- Understand future multimedia technologies.
- Apply the acquired knowledge to specific multimedia related problems and projects at work.
- Take advanced courses in this area.

UNIT -I

Introduction to Multimedia: Multimedia, World Wide Web, Overview of Multimedia Tools, Multimedia Authoring, Graphics/Image Data Types, and File Formats.

Color in Image and Video: Color Science — Image Formation, Camera Systems, Gamma Correction, Color Matching Functions, CIE Chromaticity Diagram, Color Monitor Specifications, Out-of-Gamut Colors, White Point Correction, XYZ to RGB Transform, Transform with Gamma Correction, L*A*B* Color Model. Color Models in Images — RGB Color Model for CRT Displays, Subtractive Color: CMV Color Model, Transformation from RGB to CMV, Under Color Removal: CMYK System, Printer Gamuts, Color Models in Video — Video Color Transforms, YUV Color Model, YIQ Color Model, Ycbcr Color Model.

UNIT -II

Video Concepts: Types of Video Signals, Analog Video, Digital Video.

Audio Concepts: Digitization of Sound, Quantizatiofl and Transmission of Audio.

UNIT -III

Compression Algorithms

Lossless Compression Algorithms: Run Length Coding, Variable Length Coding, Arithmetic Coding, Lossless JPEG, Image Compression.

Lossy Image Compression Algorithms: Transform Coding: KLT And DCT Coding, Wavelet Based Coding.

Image Compression Standards: JPEG and JPEG2000.

UNIT – IV

Video Compression Techniques: Introduction to Video Compression, Video Compression Based on Motion Compensation, Search for Motion Vectors, H.261- Intra-Frame and Inter-Frame Coding, Quantization, Encoder and Decoder, Overview of MPEG 1 and MPEG2.

UNIT -V

Audio Compression Techniques: ADPCM in Speech Coding, G.726 ADPCM, Vocoders Phase Insensitivity, Channel Vocoder, Formant Vocoder, Linear Predictive Coding, CELP, Hybrid Excitation Vocoders, MPEG Audio — MPEG Layers, MPEG Audio Strategy, MPEG Audio Compression Algorithms, MPEG-2 AAC, MPEG-4 Audio.

TEXT BOOKS

Fundamentals of Multimedia — Ze- Nian Li, Mark S. Drew, PHI, 2010.

Multimedia Signals & Systems — Mrinal Kr. Mandal Springer International Edition 1St Edition, 2009

REFERENCE BOOKS

Multimedia Communication Systems — Techniques, Stds&Netwroks KR. Rao, Zorans. Bojkoric, DragoradA.MjIovanj 1st Edition, 2002.

Fundamentals of Multimedia Ze- Man Li, Mark S.Drew, Pearson Education (LPE), 1st Edition, 2009.

Multimedia Systems John F. KoegelBufond Pearson Education (LPE), 1st Edition, 2003.

Digital Video Processing — A. Murat Tekaip, PHI, 1996.

Video Processing and Communications — Yaowang, JornOstermann, Ya-QinZhang, Pearson,2002

EC4433 DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To introduce architectural features of programmable DSP Processors of TI and AnalogDevices.
- To recall digital transform techniques.
- To give practical examples of DSP Processor architectures for better understanding.
- To develop the programming knowledge using Instruction set of DSP Processors.
- To understand interfacing techniques to memory and I/O devices.

Course Outcomes:

- Student will be able to:
- To distinguish between the architectural features of general purpose processors and DSP processors

- Understand the architectures of TMS 320C54XX and ADSP2100 DSP devices
- Able to write assembly language programs using instruction set of TMS320C54XX
- Can interface various devices to DSP Processors

UNIT-I: Introduction to Digital Signal Processing:

Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolationComputational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

UNIT-II: Architectures for Programmable DSP Devices:

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation UNIT, Programmability and Program Execution, Speed Issues, Features for External interfacing.

UNIT-III: Programmable Digital Signal Processors:

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors.

UNIT-IV: Analog Devices Family of DSP Devices:

Analog Devices Family of DSP Devices – ALU and MAC block diagram, ShifterInstruction,Base Architecture of ADSP 2100, ADSP-2181 high performance Processor. introduction to Blackfin Processor - The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

UNIT-V: Interfacing Memory and I/O Peripherals to Programmable DSP Devices:

Memory space organization, External bus interfacing signals, Memory interface, ParallelI/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

TEXT BOOKS:

Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.

A Practical Approach to Digital Signal Processing - K Padmanabhan, R. Vijayarajeswaran, Ananthi. S, New Age International, 2006/2009

Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007

REFERENCES:

Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.

Digital Signal Processing – Jonatham Stein, 2005, John Wiley.

DSP Processor Fundamentals, Architectures & Features – Lapsley et al. 2000, S. Chand & Co.

Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Engineering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI

The Scientist and Engineer's Guide to Digital Signal Processing by Steven W. Smith, Ph.D.,California Technical Publishing, ISBN 0-9660176-3-3, 1997 6.Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005.

EC4502 DATA MINING

Externals: 60Marks (L-T)-P-C

Internals: 40Marks 4-0-3

Objectives:

- To impart an introduction to Data Mining.
- To develop basic knowledge of how data is transformed to Data Warehouses.

UNIT - I:

Introduction to Data Mining: What is data mining? Related technologies - Machine Learning, DBMS, OLAP and Statistics. Data Mining Goals, Stages of the Data Mining Process , Data Mining Techniques. Knowledge Representation Methods, Applications. Example: weather data Data Warehouse and OLAP: Data Warehouse and DBMS, Multidimensional data model , OLAP operations, Example:loan data set.

UNIT - II:

Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies.
Data mining knowledge representation: Task relevant data, Background knowledge, Interestingness measures, Representing input data and output knowledge
Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures

UNIT - III:

Data mining algorithms: Association rules -

Motivation and terminology, Example: mining weather data, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis.
Data mining algorithms: Classification - Basic learning/mining tasks, Bayesian, Naïve Bayes , Decision trees, Covering rules, Random Forest.

UNIT - IV:

Data mining algorithms: Prediction - The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), Linear models
Evaluating what's been learned: Basic issues, Training and testing, Estimating classifier accuracy (holdout, cross-validation, leave-one-out), Combining multiple models (bagging, boosting, stacking), Minimum Description Length Principle (MLD)

UNIT - V:

Clustering: Basic issues in clustering, First conceptual clustering system: Cluster/2 , Partitioning methods: k-means, expectation maximization (EM), Hierarchical methods: distance-based agglomerative and divisible clustering
Basics of ANN, Perceptron, MLP

Suggested References:

- I. H. Witten and E. Frank. Data Mining: Practical Machine Learning Tools and Techniques. Morgan Kaufmann. 2000.
- J. Han and M. Kamber. Data Mining: Concepts and Techniques, 2nd Ed. Morgan Kaufman. 2006.
- M. H. Dunham. Data Mining: Introductory and Advanced Topics. Pearson Education. 2001.
- D. Hand, H. Mannila and P. Smyth. Principles of Data Mining. Prentice-Hall. 2001.
- Pang-Ning Tan, Michael Steinbach, Vipin Kumar. Introduction to Data Mining. Addison- Wesley Longman Publishing Co.

ECPE1_ WIRELESS COMMUNICATIONS

Externals: 60Marks

(L-T)-

P-C

Internals: 40Marks

4-0-3

Course objectives:

9. To provide the students with the fundamental theoretical and practical concepts of wireless communication
10. To equip the students with various kinds of wireless networks and its operations.
11. To prepare the students to understand the concept of frequency reuse and be able to apply it in the design of mobile cellular system
12. To prepare the students to understand various multiple access techniques that are used in wireless communications
13. To train the students to understand the basic concepts of OFDM and MIMO.
14.

Course outcomes:

14. On successful completion of this course, the students should be able to:
15. Select appropriate value of C/I to design the Antenna system
16. Analyze the characteristics of different setups for the wireless communication using new models for the coverage improvement.
17. Select different technologies to solve numerical problems using multiple access technique.
18. Demonstrate the technical aspects of diversity for wireless communication.
19. Understand the basic PAPR problem in OFDM and understanding basic concepts in SIMO.

UNIT - I

Basic Cellular system and its operation: frequency reuse, channel assignment strategies, Handoffprocess, factors influencing handoffs, handoffs in different Generations, Interference and system capacity, Crosstalk, Enhancing capacity and cell coverage, Trunked radio system, grade of service as per Erlang's B system.

UNIT – II

Propagation models: Free space propagation model, three basic propagation mechanisms, practical linkbudget design using path loss models, outdoor propagation models: Ground reflection (2-ray) Model, log normal shadowing, Okumura model, Hata model and indoor propagation model. Rayleigh fading, BER in Rayleigh fading channel with BPSK transmission,doppler spread, rms delay spread, Coherence time and Coherence bandwidth of wireless channel.

UNIT – III

Basic equalizers: LS, MMSE estimators for channel, Multiple Access Techniques: FDMA, TDMA, CDMA, RAKE receiver, SDMA.

UNIT – IV

SIMO: Diversity, SIMO (multiple receive antennas) model, maximal ratio combining (MRC) receiver, BER with MRC (high SNR approximation), diversity order.

UNIT – V

OFDM: Multicarrier basics, OFDM transmitter and receiver blocks, cyclic prefix in OFDM, PAPR problem in OFDM, SC-FDMA transmitter and receiver blocks.

Text Books:

Theodore.S. Rappaport, "Wireless Communications: Principles and Practice", 2/e, Pearson Education, 2010

Aditya K Jagannatham, "Principles of Modern Wireless Communication Systems", Mc-Graw Hill

Suggested Reading:

David Tse and Pramod Viswanath, "Fundamentals of Wireless Communications",Cambridge University Press.

EC4403 SATELLITE COMMUNICATIONS

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

12. To prepare the student to excel in basic knowledge of satellite communication principles.
13. To provide students with solid foundation in orbital mechanics and launches for the satellite communication
14. To train the students with the basic knowledge of link design of satellite with a design examples.
15. To provide the better understanding of multiple access systems and earth station technology.
16. To prepare the students with knowledge in satellite navigation and GPS and satellite packet communication

Course Outcomes:

- At the end of this course Students will be able to
- Explain, basic concepts and frequency allocations for satellite communications.
- Describe the orbital mechanics, launch vehicles and launchers.
- Design satellite links for specified C/N.
- Visualize satellites sub systems like telemetry, tracking, command and monitoring power systems etc.,
- Explain the different multiple access systems and their need in satellite communications and GPS Receivers,.

UNIT-I: Communication Satellite Orbit and Description

A Brief history of satellite Communication, satellite Frequency Bands, Satellite Systems, Applications, Orbital Period and Velocity, effects of orbital Inclination, Azimuth and Elevation, Coverage angle and slant Range, Eclipse, Orbital Perturbations,Placement of a Satellite in a Geo-Stationary orbit.

UNIT-II: Satellite Sub-Systems

Attitude and Orbit Control system, TT&C subsystem, Attitude Control subsystem,Power systems, Communication subsystems, Satellite Antenna Equipment.Satellite Link: Basic Transmission Theory, System Noise Temperature and G/T ratio, Basic LinkAnalysis, Interference Analysis, Design of satellite Links for a specified C/N, (With and without frequency Re-use), Link Budget

UNIT-III: Propagation Effects

Introduction, Atmospheric Absorption, Cloud Attenuation, Tropospheric and Ionospeheric Scintillation and Low angle fading, Rain induced attenuation, rain induced cross polarization interference. Multiple Access : Frequency Division Multiple Access (FDMA) - Intermodulation, Calculation of C/N, Time Division Multiple Access (TDMA) -Frame Structure, Burst Structure, Satellite switched TDMA, On-board Processing, Demand Assignment Multiple Access (DAMA) – Typesof Demand Assignment, Characteristics, CDMA Spread Spectrum Transmission and Reception.

UNIT-IV: Earth Station Technology

Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface,Power Test Methods, Lower Orbit Considerations. Satellite Navigation and Global Positioning Systems:Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers, GPS C/A Code Accuracy, Differential GPS.

UNIT-V: Satellite Packet Communications

Message Transmission by FDMA: M/G/1 Queue, Message Transmission by TDMA, PURE ALOHA-Satellite Packet Switching, Slotted Aloha, Packet Reservation, Tree Algorithm.

TEXT BOOKS:

1. Satellite Communications –Timothy Pratt, Charles Bostian, Jeremy Allnutt, 2ndEdition,

2003,john Wiley & Sons.

2. Satellite Communications Engineering – Wilbur, L. Pritchand, Robert A. Nelson and Heuri

G.Suyderhoud, 2ndEd., Pearson Publications.

3. Digital Satellite Communications-Tri.T.Ha, 2ndEdition, 1990, Mc.Graw Hill.

REFERENCES:

1. Satellite Communications-Dennis Roddy, 2ndEdition, 1996, McGraw Hill.

2. Satellite Communications: Design Principles –M. Richcharia, 2ndEd., BSP, 2003.

3.Digital Satellite Communications –Tri. T. Ha, 2ndEd., MGH, 1990.

4. Fundamentals of Satellite Communications –K. N. Raja Rao, PHI, 2004.

ECPE1_ WIRELESS SENSOR NETWORKS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

Unit II:

Mobile Ad-hocNetworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks

Unit III:

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee,

Dissemination protocol for large sensor network. Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

Unit IV:

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

Unit V:

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.

Course Outcomes:

At the end of the course the students will be able to

Design wireless sensor networks for a given application

Understand emerging research areas in the field of sensor networks

Understand MAC protocols used for different communication standards used in WSN

Explore new protocols for WSN

Text/Reference Books:

Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications ,2011

Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009

Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier Publications,2004

Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science

Philip Levis, And David Gay "TinyOS Programming” by Cambridge University Press 2009

ECPE1_

LARGE MIMO SYSTEMS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

- To study the various concepts of MIMO communication.
- To study Large MIMO systems encoding and decoding techniques.
- To study MIMO channel models and MIMO channel estimation.

Unit-I:

Introduction: Multi-antenna wireless channels, MIMO system model, MIMO communication with CSIR-only, Slow fading channels, Fast fading channels, MIMO communication with CSIT and CSIR, Increasing spectral efficiency: quadrature amplitude modulation (QAM) vs MIMO, Multiuser MIMO communication.

Large MIMO systems: Opportunities in large MIMO systems, Channel hardening in large dimensions, Technological challenges and solution approaches.

Unit-II:

MIMO encoding: Spatial multiplexing, Space-time coding, Space-time block codes, High-rate NO-STBCs, NO-STBCs from CDAs, Spatial modulation (SM).

MIMO detection: System model, Optimum detection, Linear detection, Interference cancellation, LR-aided linear detection, Sphere decoding

Unit-III:

Detection based on local search, Detection based on probabilistic data association (PDA), Detection/decoding based on message passing on graphical models, Detection based on MCMC techniques.

Unit-IV:

Channel estimation in large MIMO systems, MIMO capacity with imperfect CSI, Point-to-point MIMO training, Multi-user MIMO training, Large multi-user MIMO systems, Iterative channel estimation/detection in frequency-flat fading, Iterative channel estimation/equalization in ISI channels, Equalization using initial channel estimates, Equalization using the MGS-MR algorithm.

Precoding in point-to-point MIMO, Precoding in a multiuser MIMO downlink, Precoding in large multiuser MISO systems, Multicell precoding

Unit-V:

MIMO channel models: Analytical channel models, Spatial correlation based models, Propagation based models, Effect of spatial correlation on large MIMO performance: an illustration, Pinhole effect, Effect of spatial correlation on LAS detector performance, Standardized channel models, Models in IEEE 802.11 WiFi, Models in 3GPP/LTE, Large MIMO channel measurement campaigns, Compact antenna arrays, PIFAs as elements in compact arrays, MIMO cubes

Text Books:

1. A.Chockalingam and B.Sundar Rajan, “Large MIMO Systems”, Cambridge University Press, 2014.

Reference Books:

1. D. Tse and P. Viswanath, Fundamentals of Wireless Communication. Cambridge, UK: Cambridge University, 2005.

2. H. Jafarkhani, Space-Time Coding: Theory and Practice. Cambridge, UK: Cambridge University Press, 2005.

ECPE1_ Applied Optimization for Wireless, Signal Processing, Machine Learning

Externals: 60Marks **L-T-P-C**
Internals: 40Marks **3-0-0-3**

Course Objectives:

1. To study the concepts of local minima and global minima, and study of some Numerical optimization techniques.

2. To study the Convex optimization concepts.

3. To study the formulation and solving various optimization problems related to Wireless communications, signal processing and Machine learning.

Unit-I:

Introduction to properties of Vectors, Norms, Positive Semi-Definite matrices, Gaussian Random
Vectors, Local minimum, global minimum, Optimization Problem formulation examples: Bus terminus problem, Transportation problem, regression problem. Steepest Descent algorithm.

Unit-II:

Introduction to Convex Optimization – Convex sets, Hyperplanes/ Half-spaces etc. Application: Power constraints in Wireless Systems, Convex/ Concave Functions, Examples, Conditions for Convexity. Application: Beamforming in Wireless Systems, Multi-User Wireless, Cognitive Radio Systems, Convex Optimization problems, Linear Program, Application: Power allocation in Multi-cell cooperative OFDM

Unit-III:

SOCP Problems, Application: Channel shortening for Wireless Equalization, Robust Beamforming in Wireless Systems, Duality Principle and KKT Framework for Optimization. Application: Water-filling power allocation, Optimization for MIMO Systems, OFDM Systems and MIMO-OFDM systems

Unit-IV:

Optimization for signal estimation, LS, WLS, Regularization. Application: Wireless channel estimation, Image Reconstruction-Deblurring, Application: Convex optimization for Machine Learning, Principal Component Analysis (PCA), Support Vector Machines

Unit-V:

Application: Cooperative Communication, Optimal Power Allocation for cooperative Communication, Application: Compressive Sensing, Sparse Signal Processing, OMP (Orthogonal Matching Pursuit), LASSO (Least Absolute Shrinkage and Selection Operator) for signal estimation

Text Books:

1. Stephen Boyd, Convex Optimization, Cambridge University Press.

Reference Books:

1. Convex Optimization Algorithms, by Dimitri P. Bertsekas, 2015, Athena scientific

Reference NPTEL MOOCs:

Applied Optimization for Wireless, Machine Learning, Big-Data by Prof. Aditya K. Jagannatham

ECPE1_ Principles of Signal Estimation for MIMO/OFDM Wireless Communications

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

1. To study the ML estimation concept.

2. To study the MMSE estimation concept.

3. To study the estimation problems related to wireless sensor network, wireless fading channel, channel equalizer, OFDM.

Unit-I:

Basics of Estimation, Maximum Likelihood (ML), Application: Wireless Sensor Network, Reliability of Estimation, Wireless Fading Channel Estimation, Cramer-Rao Bound for Estimation

Unit-II:

Vector Parameter Estimation, Properties of Estimate; Applications: Multi-antenna Wireless Channel Estimation, MIMO Wireless Channel Estimation, Error

Covariance of Estimation, Equalization for Frequency Selective Channels

Unit-III:
OFDM Estimation, Sequential Estimation, Minimum Mean-Squared Error (MMSE) Estimate, Gaussian Parameter, Application: Wireless Sensor Network, Wireless Fading Channel Estimation

Unit-IV:
MMSE Estimation for Multi-Antenna Channel, MMSE for MIMO Channel Estimation, Properties of Estimate

Unit-V:
MMSE for Equalization of Wireless Channel, MMSE for OFDM Channel Estimation

Reference NPTEL MOOCs:
1. Principles of Signal Estimation for MIMO/OFDM Wireless Communications by Prof. Aditya K. Jagannatham

EC4402 ERROR CORRECTING CODES
Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To study the importance of channel coding techniques in digital communications.
- To learn the mathematical structure of various codes
- To learn the algorithms for various codes
- To study the various application of codes.
- To acquire the knowledge of measurement of information

Course Outcomes:

12. At the end of this course Students will be able to
13. Understand principles of channel Coding techniques.
14. Analyze the performance of different codes.
15. Design various codes like block codes, cyclic codes, convolution codes, turbo codes etc.
16. Generate different codes.
17. Estimate the information content and errors

UNIT-I

Coding for Reliable Digital Transmission and Storage: Introduction, Types of codes, Types of errors, Channels models, Modulation and coding, channel coding Theorem, Channel coding gain.

UNIT-II

Linear Block codes: Introduction, encoding, syndrome decoding, error-detecting and correcting

capabilities, Maximum likelihood decoding.Cyclic codes: Description, encoding and syndrome decoding.

UNIT- III

Galois Fields: Groups, Fields, Binary arithmetic, Construction of Galois Fields GF(2m), Basic properties of Galois Fields. RS codes: Introduction, encoding and decoding (Berlekamp-Massey algorithm).

UNIT- IV

Convolution codes: Introduction, Encoding, State diagram, Trellis diagram, Decoding - Maximum-Likelihood decoding, soft decision and hard decision decoding, Viterbi algorithm.

UNIT- V

Turbo codes: Concatenation, Types of Concatenation, interleaving, types of interleavers, Turbo codes: Introduction, encoding and decoding (BCJR Algorithm).

Text books:

Shulin and Daniel J. Costello, Jr. "Error Control Coding," 2/e, Pearson, 2011.

L.H.Charles LEE "Error control block codes for Communication Engineers", Artech, 2000.

Suggested readings:

Simon Haykin, "Communication Systems", 4/e, Wiley, 2000.

K Sam Shanmugum, "Digital and Analog Communication Systems", Wiley, 2005.

ECPE1_
INFORMATION THEORY AND CODING

Externals: 60Marks **L-T-P-C**

Internals: 40Marks 3-0-0-3

Basics of information theory, entropy for discrete ensembles; Shannon's noiseless codingtheorem; Encoding of discrete sources.

Markov sources; Shannon's noisy coding theorem and converse for discrete channels;Calculation of channel capacity and bounds for discrete channels; Application to continuous channels.

Techniques of coding and decoding; Huffman codes and uniquely detectable codes;Cyclic codes, convolutional arithmetic codes.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand the concept of information and entropy

Understand Shannon's theorem for coding

Calculation of channel capacity

Apply coding techniques

Text/Reference Books:

N. Abramson, Information and Coding, McGraw Hill, 1963.

M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

R.B. Ash, Information Theory, Prentice Hall, 1970.

Shu Lin and D.J. Costello Jr., Error Control Coding, Prentice Hall, 1983.

EC4405 RADAR SYSTEMS
Externals: 60Marks (L-T)-P-C

Internals: 40Marks 4-0-3

Course Objectives:

9. To learn working principle of Radar Operating frequencies and derive Radar Range Equation,
10. To understand the basic concepts of different types of Radars for surveillance & Tracking.
11. To learn functioning of MTI radar and its performance limitations.
12. To get acquainted with the working principles of CW radar, FM-CW radar.
13. To understand concept of a Matched Filter in Radar Receivers gain knowledge of different receiver blocks and understand receiver functioning

Course Outcomes:

10. At the end of this course Students will learn:
11. Distinguish between thefunctioning of CW FM-CW and MTI radars,

12. Apply Doppler principle to radars and hence detect moving targets.
13. Distinguish between Sequential Lobing, Conical Scan, Monopulse type 0f Tracking Radars, specify their requirements and compare their characteristic features.
14. Derive the matched filter response characteristics for radar applications and account for correlation receivers; to distinguish between different radar displays and duplexers.
15. Account for the electronic scanning principle and implement the same through phased array antennas, knowing their requirements and utilities.

UNIT-I: Basics of Radar

Introduction, Maximum Unambiguous Range, Radar Waveforms, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Predictionof Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, Related Problems. Radar Equation: SNR, Envelope Detector-False AlarmTime and Probability, Integration of Radar Pulses,Radar Cross Section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Related Problems.

UNIT-II: CW and Frequency Modulated RadarDoppler Effect

CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Related Problems.FM-CW Radar: FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar.

UNIT-III: MTI and Pulse Doppler Radar

Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler Radar.Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar –Amplitude Comparison Monopulse (one- and two- coordinates), Angular Accuracy, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

UNIT-IV: Detection of Radar Signals in Noise

Introduction, Matched Filter Receiver – Response Characteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non- matched Filters, Matched Filter with Non-white Noise.

UNIT-V: Radar Receivers

Noise Figure and Noise Temperature, Displays – types, Introduction to Phased Array Antennas –Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Applications, Advantages and Limitations.ElectronicWarfare : Introduction to ESM, ECM and ECCM systems.

TEXT BOOKS:

1.Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2 nd

Edition, Tata McGraw-Hill, 2007.

REFERENCES:

1. Introduction to Radar Systems – Merrill I. Skolnik, 3 rd Edition Tata McGraw-Hill, 2001.

2. Radar: Principles, Technology, Applications-Byron Edde, Pearson Education, 2004.

3. Principles of Modern Radar: Basic Principles-Mark A. Richards, James A. Scheer, William

A. Holm, Yesdee,2013.

4. 'Radar Hand Book ' Ed. By M.I Skolnik, 2 nd Edition, Tata McGraw Hill.

5. 'Understanding Radar Systems' by Simon Kinsley and Shaun Quegan, Scitech Publishing,

McGraw-Hill.

EC4425 ADHOC WIRELESS SENSOR NETWORKS

Externals: 60Marks

(L-T)-P-C

Internals: 40Marks

4-0-3

Course Objectives:

- To introduction of fundamentals of Wireless LANS and PANS and its design issues.
- To understand the MAC protocols for Ad Hoc Wireless Networks and its designingissues.
- To introduction of different kinds of Routing algorithms for effective design of Ad HocWireless Networks.
- To introduction and designing issues in Transport Layer Protocol for Ad Hoc WirelessNetworks.
- Introduction of Wireless Sensor Networks and its Architecture.
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Course Outcomes:

- At the end of this course Students will learn
- Students will be good at fundamentals of Wireless LANS and PANS and its designissues.
- Students will know the MAC protocols for Ad Hoc Wireless Networks and its
- designing issues.
- Student knows the different kinds of Routing algorithms for effective design of Ad
- Hoc Wireless Networks.
- Student will be ability to overcome the issues in Transport Layer Protocol for Ad Hoc
- Wireless Networks.
- Finally, student will be good at design and architecture of Wireless Sensor Networks.

UNIT -I:

Wireless LANS and PANS: Introduction, Fundamentals of WLANS, IEEE 802.11 Standards,HIPERLAN Standard, Bluetooth, Home RF.AD HOC Wireless Networks: Introduction, Issues in Ad Hoc Wireless Networks.

UNIT -II:

MAC Protocols: Introduction, Issues in Designing a MAC protocol for Ad Hoc Wireless Networks, Design goals of a MAC Protocol for Ad Hoc Wireless Networks, Classifications of MAC Protocols, Contention - Based Protocols, Contention - Based Protocols with reservation

Mechanisms,Contention – Based MAC Protocols with Scheduling Mechanisms, MAC Protocolsthat use Directional Antennas, Other MAC Protocols.

UNIT -III:

Routing Protocols: Introduction, Issues in Designing a Routing Protocol for Ad Hoc WirelessNetworks, Classification of Routing Protocols, Table –Driven Routing Protocols, On – DemandRouting Protocols, Hybrid Routing Protocols, Routing Protocols with Efficient Flooding Mechanisms, Hierarchical Routing Protocols, Power – Aware Routing Protocols.

UNIT –IV:

Transport Layer Protocols: Introduction, Issues in Designing a Transport Layer Protocol for AdHoc Wireless Networks, Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks, Classification of Transport Layer Solutions, TCP Over Ad Hoc Wireless Networks, Other Transport Layer Protocol for Ad Hoc Wireless Networks.

UNIT –V:

Wireless Sensor Networks: Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering, MAC Protocols for Sensor Networks, Location Discovery, Quality of a Sensor Network, Evolving Standards, Other Issues.

TEXT BOOKS:

Ad Hoc Wireless Networks: Architectures and Protocols - C. Siva Ram Murthy and B.S.Manoj, 2004, PHI.

Wireless Ad- hoc and Sensor Networks: Protocols, Performance and Control – JagannathanSarangapani, CRC Press.

REFERENCES:

Ad- Hoc Mobile Wireless Networks: Protocols & Systems, C.K. Toh , 1st Ed. Pearson Education.

Wireless Sensor Networks - C. S. Raghavendra, Krishna M. Sivalingam, 2004, Springer.

IoT and Applications

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

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ECPE1_ IoT Lab

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objective.

The course aims to introduce students to the concepts underlying the Internet of Things (IoT) through a series of lectures on the various topics that are important to understand the state-of-the-art as well as the trends for IoT. The students will be introduced to the history and evolution of IoT, as well as case studies from various industry domains. In addition, students will be required to work in teams to design, build, evaluate and test an innovative IoT system for a specific industry domain, such as sports and agriculture. Students will also be required to present their innovations to their peers in class as well as to the public (at the end of the course), and will also be required to document their findings in the form of a conference-style research paper. Students will also be exposed to real-world sports technologies, to witness these technologies in action behind-the-scenes, and to interact with experts from the industry.**

The lectures will be focused around industry domains (the verticals where IoT is applicable, or has been applied), platforms (the hardware or software platforms that are applicable for IoT), protocols (the communication protocols that are applicable to IoT) and services (the types of services that can layer over IoT).

TOPICS

Industry domains

IoT in Sports

IoT in Cities/Transportation

IoT in the Home

IoT in Retail

IoT in Healthcare

Platforms

Hardware, SoC, sensors, device drivers, IoT standards

Cloud computing for IoT

Bluetooth, Bluetooth Low Energy, beacons

Protocols

NFC, RFID, Zigbee

MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe

Wired vs. Wireless communication

GSM, CDMA, LTE, GPRS, small cell

Services/Attributes

Big-Data Analytics and Visualization

Dependability

Security

Maintainability

UNIT-I: Introduction & Concepts

Introduction & Concepts: Introduction to Internet of Things- Definitions & Characteristics of

IoT, Physical Design of IOT-Things in IoT, IoT Protocols, Logical Design of IOT-IoT Functional Blocks, IoT Communication Models, IoT Communication APIs, IOT Enabling Technologies- Wireless Sensor Networks, Cloud Computing, Big Data Analytics,Communication Protocols, Embedded Systems, IOT Levels & Deployment Templates.

UNIT-II: Domain Specific IoTs and M2M

IoT applications for Home Automation, Cities, Environment, Energy,Retail, Logistics,

Agriculture, Industry, health and Lifestyle

IoT and M2M – Introduction to M2M, Similarities and Differences between IoT and M2M.

UNIT-III: : IoT Platforms Design Methodology

Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process

Specification, Domain Model Specification, Information Model Specification, Service

Specifications, IoT Level Specification, Functional View Specification, Operational View

Specification, Device and Component Integration, Application Development, Case Study on IoT

System for Weather Monitoring.

UNIT-IV: Introduction to Python

Motivation for using Python for designing IoT systems, Language features of Python, Data

types- Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, Data Structures: Control

of flow-if, for, while, range, break/continue, pass, functions, modules, packaging, file handling,

data/time operations, classes, Exception handling, Python packages of Interest for IoT - JSON,

XML, HTTPLib, URLLib, SMTPLib

UNIT-V: IoT Physical Devices and End Points

Basic building blocks of an IoT device, Rasberry Pi-About theRasberry Pi board, Rasberry Pi

interfaces-Serial, SPI,I2C, Interfacing an LED and switch with RPi and controlling.

Other IoT Devices- pcDuino, BeagleBone Black, CubieboardIoT

Course Outcome:

The Student is expected to design and develop an IoT real-world application in a specific domain arming with knowledge of Python and choosing hardware for specific application.

Textbook:

Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.

Referencens:

Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

Various research papers and articles recommended during course work.

EC4413
EMBEDDED SYSTEMS

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

13. Understand the basics of an embedded system.
14. Program an embedded system.
15. To learn the design process of embedded system applications.
16. To understands the RTOS and inter-process communication.
17. To understand different communication interfaces.

Course Outcomes:

18. At the end of this course Students will learn:
19. Understand and design the embedded systems
20. Learn the basics of OS and RTOS.
21. Understand types of memory and interfacing to external world.
22. Understand embedded firmware design approaches.
23. Understand the interfacing of communication devices.

UNIT-I: INTRODUCTION TO EMBEDDED SYSTEMS

Complex systems and microprocessors-embedding computers, characteristics of embedded computing applications, challenges in embedded computing system design, performance in embedded computing; The embedded system design process-requirements, specification, architecture design, designing hardware and software, components, system integration, design example.

UNIT-II: TYPICAL EMBEDDED SYSTEM

Core of the embedded system-general purpose and domain specific processors, ASICs, PLDs, COTs; Memory-ROM, RAM, memory according to the type of interface, memory shadowing, memory selection for embedded systems; Sensors, actuators and other components-sensors, actuators, seven segment LED, relay, piezo buzzer, push button switch, reset circuit, brownout protection circuit, oscillator circuit real time clock, watch dog timer.

UNIT-III: EMBEDDED FIRMWARE DESIGN AND DEVELOPMENT

Embedded firmware design approaches-super loop based approach, operating system based approach; Embedded firmware development languages-assembly language based development, high level language based development; Programming in embedded C.

UNIT-IV: RTOS BASED EMBEDDED SYSTEM DESIGN

Operating system basics, types of operating systems, tasks, process and threads, multiprocessing and multitasking, task scheduling: non-preemptive and pre-emptive scheduling; task communication-shared memory, message passing.

UNIT-V: COMMUNICATION INTERFACE

Onboard communication interfaces-I2C, SPI, UART, 1 wire interface, parallel interface; External communication interfaces-RS232 and RS485,USB, infrared, Bluetooth, wi-Fi, zigbee, GPRS; Automotive networks and sensor networks.

TEXT BOOKS:

Computers as Components –Wayne Wolf, Morgan Kaufmann (second edition).

Introduction to Embedded Systems - shibu k v, Mc Graw Hill Education.

REFERENCES:

Embedded System Design -frank vahid, tony grivargis, john Wiley.

Embedded Systems- An integrated approach - Lyla b das, Pearson education 2012.

Embedded Systems – Raj kamal, TMH. 4. An embedded Software Primer, David e Simon, Pearson education

ECPE1_
NANO ELECTRONICS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Introduction to nanotechnology, meso structures,Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig-Penny Model. Brillouin Zones.

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets,

Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.),

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors,Carbon nanotube electronics, Bandstructure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand various aspects of nano-technology and the processes involved in making nano components and material.

Leverage advantages of the nano-materials and appropriate use in solving practical problems.

Understand various aspects of nano-technology and theprocesses involved in making nano components and material.

Leverage advantages of the nano-materials and appropriate use in solving practical problems.

Text/ Reference Books:

G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.

W. Ranier, Nanoelectronics and Information Technology (Advanced Electronic Materialand Novel Devices), Wiley-VCH, 2003.

K.E. Drexler, Nanosystems, Wiley, 1992.

J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press, 1998.

C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003

ECPE1_
INTRODUCTION TO MEMS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Introduction and Historical Background, Scaling Effects. Micro/Nano Sensors, Actuators and

Systems overview: Case studies. Review of Basic MEMS fabrication modules: Oxidation, Deposition Techniques, Lithography (LIGA), and Etching. Micromachining: Surface Micromachining, sacrificial layer processes, Stiction; Bulk

Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding. Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear

Thermal Expansion, Bending; Energy methods, Overview of Finite Element Method, Modeling of Coupled Electromechanical Systems.

Course Outcomes:

At the end of the course the students will be able to

Appreciate the underlying working principles of MEMS and NEMS devices.

Design and model MEM devices.

Text/Reference Book:

G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India, 2012.

S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Microengineering (Vol. 8). CRC press, (2005).

S. D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001.

M. Madou, Fundamentals of Microfabrication, CRC Press, 1997.

G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston, 1998.

M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers, and Gyroscopes, Elsevier, New York, 2000.

ECPE1_ **MIXED SIGNAL DESIGN**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Analog and discrete-time signal processing, introduction to sampling theory;Analog continuoustime filters: passive and active filters; Basics of analog discrete-time filters and Z-transform.

Unit II:

Switched-capacitor filters- Nonidealities in switched-capacitor filters; Switched-capacitor filter architectures; Switched-capacitor filter applications.

Unit III:

Basics of data converters; Successive approximation ADCs, Dual slope ADCs,Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

Unit IV:

Mixed-signal layout, Interconnects and data transmission; Voltage-mode signalingand data transmission; Current-mode signaling and data transmission.

Unit V:

Introduction to frequency synthesizers and synchronization; Basics of PLL,Analog PLLs; Digital PLs; DLLs.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand the practical situations where mixed signal analysis is required.

Analyze and handle the inter-conversions between signals.

Design systems involving mixed signals

Text/Reference Books:

R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008.

Behzad Razavi , Design of analog CMOS integrated circuits, McGraw-Hill, 2003.

R. Jacob Baker, CMOS circuit design, layout and simulation, Revised second edition, IEEE press, 2008.

Rudy V. dePlassche, CMOS Integrated ADCs and DACs, Springer, Indian edition, 2005.

Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill, 1981.

R. Schauman, Design of analog filters by, Prentice-Hall 1990 (or newer additions).

M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford university press, first Indian edition, 2008.

ECPE1_ CMOS DESIGN

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor.Transistor as a switch. Inverter characteristics, Integrated Circuit Layout: Design Rules, Parasitics. Delay: RC Delay model, linear delay model, logical path efforts. Power, interconnect and Robustness in CMOS circuit layout. Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic. Sequential Circuit Design: Static circuits. Design of latches and Flip-flops.

Course Outcomes:

At the end of the course the students will be able to

Design different CMOS circuits using various logic families along with their circuit layout.

Use tools for VLSI IC design.

Text/Reference Books:

N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems

Perspective, 4thEdition, Pearson Education India, 2011.

C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979.

J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997.

P. Douglas, VHDL: programming by example, McGraw Hill, 2013.

L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley, 1985.

ECPE1_
POWER ELECTRONICS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Characteristics of Semiconductor Power Devices: Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based).Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

Unit II:

Controlled Rectifiers: Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, Input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

Unit III:

Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper

Unit IV:

Single-phase inverters: Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter

Unit V:

Switching Power Supplies: Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, Load resonant converter - series loaded half bridge DC-DC converter.

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS. Separately excited DC motor drive. P M Stepper motor Drive.

Course Outcomes:

At the end of this course students will demonstrate the ability to

Build and test circuits using power devices such as SCR

Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,

Learn how to analyze these inverters and some basic applications.

Design SMPS.

Text /Reference Books:

Muhammad H. Rashid, "Power electronics" Prentice Hall of India.

Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.

P.C. Sen., "Modern Power Electronics", edition II, Chand& Co.

V.R.Moorthi, "Power Electronics", Oxford University Press.

Cyril W., Lander," Power Electronics", edition III, McGraw Hill.

G K Dubey, S R Doradla,: Thyristorised Power Controllers", New Age International Publishers. SCR manual from GE, USA.

ECPE1_ HIGH SPEED ELECTRONICS

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Transmission line theory (basics) crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency powerdelivery, methodologies for design of high speed buses; radiated emissions and minimizing system noise;

Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion,

Intermodulation,Cross-modulation, Dynamic range

Unit II:

Devices: Passive and active, Lumped passive devices (models), Active (models,low vs highfrequency)

Unit III:

RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages

Unit IV:

Mixers –Upconversion Downconversion, Conversion gain and spurious response.Oscillators Principles.PLL Transceiver architectures

Unit V:

Printed Circuit BoardAnatomy, CAD tools for PCB design, Standard fabrication, Microvia Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand significance and the areas of application of high-speed electronics circuits.

Understand the properties of various components used in high speed electronics

Design High-speed electronic system using appropriate components.

Text/Reference Books:

Stephen H. Hall, Garrett W. Hall, James A. McCall “High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices”, August 2000, Wiley-IEEE Press

Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, CambridgeUniversity Press, 2004, ISBN 0521835399.

Behzad Razavi, “RF Microelectronics”, Prentice-Hall 1998, ISBN 0-13-887571-5.

Guillermo Gonzalez, “Microwave Transistor Amplifiers”, 2nd Edition, Prentice Hall.

Kai Chang, “RF and Microwave Wireless systems”, Wiley.

R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

ECPE1_ EMBEDDED SYSTEMS DESIGN

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Prerequisite: Microprocessor and Microcontrollers Course

Objectives:

1. To provide an overview of Design Principles of Embedded System.

2. To provide clear understanding about the role of firmware , operating systems in correlation with hardware systems.

Course Outcomes:

1. Expected to understand the selection procedure of Processors in the Embedded domain.

2. Design Procedure for Embedded Firmware.

3. Expected to visualize the role of Real time Operating Systems in Embedded Systems

4. Expected to evaluate the Correlation between task synchronization and latency issues

UNIT -I:

Introduction to Embedded Systems Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

UNIT -II:

Typical Embedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Shadowing, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT -III:

Embedded Firmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded

Firmware Design Approaches and Development Languages.

UNIT -IV:

RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

UNIT -V:

Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.

TEXT BOOKS:

Introduction to Embedded Systems - Shibu K.V, Mc Graw Hill.

REFERENCE BOOKS:

Embedded Systems - Raj Kamal, TMH.

Embedded System Design - Frank Vahid, Tony Givargis, John Wiley.

Embedded Systems – Lyla, Pearson, 2013

An Embedded Software Primer - David E. Simon, Pearson Education.

EC4421 ANALOG VLSI AND MIXED SIGNAL DESIGN

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objective:

12. To understand the types of active filters and its operation.
13. To understand the types of continuous time filters and digital filters and its operation.
14. To understand various ADC and DAC converters and its importance in the Electronic systems.
15. Gives Knowledge on VHDL Programming language for Mixed Signal Circuit Design.

16. Extension the Verilog concepts for analog VLSI circuits.

Course Outcomes:

17. Able to design filters with active devices only.
18. Able to design the first and second order digital filters.
19. The ability to use and design DAC and ADC techniques for data conversions.
20. The ability to program, Mixed Signal VLSI Circuits.
21. Verilog program for analog VLSI circuits.

UNIT I: Introduction to Active Filters (PLL) & Switched capacitor filters

Active RC Filters for monolithic filer design: First & Second order filter realizations - universal active filter (KHN)-self tuned filter - programmable filters - Switched capacitor filters: Switchedcapacitor resistors - amplifiers –comparators - sample & hold circuits – Integrator- Biquad.

UNIT II: Continuous Time filters & Digital Filters

Introduction to Gm - C filters - bipolar transconductors - CMOS Transconductors using Triode transistors, active transistors - BiCMOStransconductors – MOSFET C Filters - Tuning Circuitry - Dynamic range performance -Digital Filters: Sampling – decimation – interpolation - implementation of FIR and IIR filters.

UNIT III: Digital to Analog & Analog to Digital Converters

Non-idealities in the DAC - Types of DAC’s: Current switched, Resistive, Charge redistribution (capacitive), Hybrid, segmented DAC’s - Techniques for improving linearity - Analog to Digital Converters: quantization errors -non-idealities - types of ADC’s: Flash, two step, pipelined, successive approximation, folding ADC’s.Sigma Delta Converters: Over sampled converters - over sampling without noise & with noise – implementation imperfections - first order modulator - decimation filters- second order modulator - sigma delta DAC & ADC’s

UNIT IV: Analog and Mixed Signal Extensions to VHDL

Introduction - Language design objectives - Theory of differential algebraic equations - the 1076 .1 Language - Tolerance groups - Conservative systems - Time and the simulation cycle -A/D and D/A Interaction - Quiescent Point - Frequency domain modeling and examples.

UNIT V: Analog Extensions to Verilog

Introduction –data types – Expressions-Signals-Analog Behavior-Hierarchical structures-Mixed Signal Interaction. Introduction - Equation construction - solution - waveform Filter functions - simulator - Control Analysis - Multi -disciplinary model.

TEXT BOOKS:

David A. Johns, Ken Martin, “Analog Integrated Circuit Design” John Wiley & Sons, 2002.

Rudy van de Plassche "Integrated Analog-to-Digital and Digital-to-Analog Converters ",Kluwer 1999.

Antoniou, "Digital Filters Analysis and Design" Tata McGraw Hill, 1998.

REFERENCES:

Phillip Allen and Douglas Holmberg "CMOS Analog Circuit Design" Oxford University. Press, 2000.

BenhardRazavi, "Data Converters", Kluwer Publishers, 1999.

Jacob Baker, Harry W LI, and David E Boyce "CMOS, Circuit Design Layout and Simulation", Wiley- IEEE Press, 1 st Edition, 1997.

Tsividis Y P, "Mixed Analog and Digital VLSI Devices and Technology", Mc-Graw Hill,1996.

ECPE1_ CMOS ANALOG VLSI DESIGN

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

COURSE OBJECTIVES

1. To understand CMOS analog circuits design
2. To simulate Analog circuits using H SPICE.
3. To learn noise modeling of CMOS analog circuits

UNIT I - ANALOG CMOS SUB-CIRCUITS

Introduction to analog design, Passive and active current mirrors, band-gap references, Switched Capacitor circuits - basic principles, sampling switches, switched capacitor integrator, switched capacitor amplifier, simulation of CMOS sub circuits using SPICE.

UNIT II - CMOS SINGLE STAGE AMPLIFIERS

Common-Source stage (with resistive load, diode connected load, current-source load, triode load, source degeneration), source follower, common-gate stage, cascode stage, folded cascode stage. Frequency responses of CS stage, CD stage, CG stage, cascode stage, simulation of CMOS amplifiers using SPICE.

UNIT III - DIFFERENTIAL AMPLIFIER & OPERATIONAL AMPLIFIERS

Single-ended and differential operation, basic differential pair – qualitative and quantitative analyses, common-mode response, differential pair with MOS loads, Performance parameters of
op-amp, one stage op-amp, two-stage CMOS op-amp, Gain boosting, slew rate, power supply
rejection, Simulation of differential amplifiers using SPICE.

UNIT IV - OSCILLATORS

General considerations, Ring oscillators, LC oscillators – cross-coupled oscillators, Colpitts
oscillator, One-port oscillator, and voltage controlled oscillators. Simulation of oscillators using
SPICE.

UNIT V - NOISE CHARACTERISTICS

Statistical characteristics of noise, Types of noise - thermal noise, flicker noise, Representation
of noise in circuits, noise in single-stage amplifiers (CS, CD and CG stages), noise bandwidth.

TEXT BOOK

Razavi, *"Design of analog CMOS integrated circuits",* McGraw Hill, Edition 2002.

REFERENCES

1. Gray, Meyer, Lewis, Hurst, *"Analysis and design of Analog Integrated Circuits",* Willey
International, 4th Edition, 2002.

2. Allen, Holberg, *"CMOS analog circuit design",* Oxford University Press, 2nd Edition,
2012.

COURSE OUTCOMES

1. Analog circuits are essential in interfacing and building amplifiers and low pass filters.
2. Able to do the design of analog sublevel blocks.
3. Learn some design methods for CMOS analog circuit.

ECPE1 CMOS DIGITAL VLSI DESIGN

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

1. This is an introductory course which covers basic theories and techniques of digital VLSI Circuit design in CMOS technology.

2. In this course, we will study the fundamental concepts and structures of MOS Transistor and designing digital VLSI Circuits, static and dynamic Power Dissipation, interconnect analysis, Propagation delays, MOS Inverters and their Characteristics.

3. The course is designed to give the student an understanding of the different Combinational circuit design, Sequential MOS Logic Gates and CMOS Dynamic Logic Circuits including their Transient Analysis, design steps and behavior.

Unit I MOS Transistor-First Glance at the MOS device, MOS Transistor under static conditions, threshold voltage, Resistive operation, saturation region, channel length modulation, velocity saturation, Hot carrier effect-drain current Vs voltage charts, sub threshold conduction, equivalent resistance, MOS structure capacitance & CMOS logics.

Unit II MOS Inverter, Switching characteristics & Interconnect Effects- Delay Time, Interconnect Parasitic Capacitances, Resistance, RC Delays, Inductances, Gate Delays, Stage Ratio, Power Dissipation, CMOS Logic Gate Design, Transmission Gate & BiCMOS.

Unit III Combinational Circuit Design: NAND Gate, NOR Gate, Transient Analysis of NAND & NOR Gate. Sequential MOS Logic Gates: Behavior of Bitable element, CMOS latches & Clocked Flip-Flops, Clock Skew & Clocking Strategies.

Unit IV CMOS Dynamic Logic Circuits: Pass Transistor Logic-0 and 1 transfer, Charge Storage & Leakage. Voltage Bootstrapping. High Performance Dynamic CMOS Circuits: Domino CMOS Logic. NORA CMOS Logic, Zipper CMOS Circuits, TSPC Dynamic CMOS.

Unit V Semiconductor Memories: ROM, DRAM, SRAM, PLA, Cell, Leakage Circuit and Input/output Circuit.

Text books:

1.Jan.M.Rabaey., Anitha Chandrakasan Borivoje Nikolic, "Digital Integrated Circuits", SecondEdition.

2.Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital IC- Analysis and Design", 3rd Edition, Tata McGraw Hill.

Reference books:

1.Neil H.E Weste and Kamran Eshraghian, "Principles of CMOS VLSI Design", 2nd Edition, Addition Wesley, 1998.

COURSE OUTCOMES

1. Able to design digital circuits in circuit-level.

2. Able to have a digital circuit design with optimizing speed and area.

3. Semiconductor memories cell can be enhanced with the existed memory cells.

EC4411 REAL TIME OPERATING SYSTEMS
Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

12. To understand the need of real time operating system.
13. To learn the basic concepts of inter process communication (IPC).
14. To analyze various scheduling algorithms related to RTOS.
15. To introduce the elementary concepts of Vx works.
16. To study the basic concepts of UNIX operating system.

Course Outcomes:

11. At the end of this course Students will learn:
12. 1.Understand Real-time operating system requirements and applications.
13. Categorize different scheduling approaches for real time scheduler.
14. Compare different real time systems.
15. Analyze a module and understand design issues.

16. Develop a real time embedded system module.

UNIT-I:

Introduction to Real Time Systems Structures of Operating System (Monolithic, Microkernel, Layered, Exo-kernel and Hybrid kernel structures), Operating system objectives and functions, Virtual Computers, Interaction of OS and Hardware architecture, Evolution of operating systems, Batch, multi programming. Multitasking, Multiuser, parallel, distributed and real-time OS.

UNIT-II:

Process Management of OS/RTOS Hard versus Soft Real-Time System: Jobs and Processors, release time, deadlines, and timing constraints, hard and soft timing constraints, hard real-time systems. Uniprocessor Scheduling: Types of scheduling, scheduling algorithms: FCFS, SJF, Priority, Round Robin, UNIX Multi-level feedback queue scheduling, Thread scheduling, Multiprocessor scheduling concept, Real Time scheduling concept.

UNIT-III:

Real Time Operating System Concepts Foreground and Background Systems, Shared Resource, Critical section of a Code, Multi-Tasking, Task, Context switch, Kernel, Scheduler, Preemptive and non-preemptive kernel, Inter Task Communication: Message Mailboxes, Message queues or pipes and Event flags, Semaphores, Interrupts

UNIT-IV:

Introduction to Vx works/UNIX OS Elementary Concepts of Vx Works: Multitasking, Task State Transition, Task Control- Task Creation and Activation, Task Stack, Task Names and IDs, Task Options, Task Information, Task Deletion and Deletion Safety. Fundamental Concepts of UNIX Operating Systems UNIX Kernel – File system, Concepts of – Process, Concurrent Execution & Interrupts. Process Management – forks & execution. Basic level Programming with system calls, Shell programming and filters.

UNIT-V:

Linux development process Types of Host /Target Development and debug setup, Generic Architecture of an Embedded Linux System, System start up, Types of Boot configurations, System Memory Layout, Development Tools: Project Workspace, IDE, GNCC cross platform, selecting and configuring kernel, setting up boot loader.

TEXT BOOKS:

Tanenbaum,"Modern Operating Systems," 4/e, Pearson Edition, 2014.

Jane W.S.Liu, Real Time Systems, Pearson Education, Asia, 2001. REFERENCES: 1. Jean J Labrosse,"Embedded Systems Building Blocks Complete and Ready-to-use Modules in C" ,2/e, CRC Press ,1999. 2. Karim Yaghmour, Jon Masters, Gilad Ben-Yesset, Philippe Gerum, "Building Embedded Linux Systems", O'Reilly Media, 2008.

Wind River Systems, "VxWorks Programmers Guide 5.5", Wind River Systems Inc.2002.

EC4423 CAD FOR VLSI CIRCUITS
Externals: 60Marks **(L-T)-P-C**
Internals: 40Marks **4-0-3**

Course Objectives:

- To make understand the VLSI CAD tools flow with Algorithmic Graphs.
- Gives knowledge on layout design rules and various algorithms for placement and partitioning of circuits.
- Understands the Floor planning and routing process in the VLSI CAD tools.
- Knows the various concepts of simulation and synthesis process in VLSI CAD tools.
- Gives Knowledge on modelling concepts of synthesis process.

Course Outcomes:

- Understands the complete VLSI CAD tool flow.
- Able to follow the design rules and debug it while creating layouts for circuits in VLSI CAD tool and also understands the placement and partitioning of the digital systems.
- Able to debug the floor planning and routing problems in the VLSI CAD tools for the digital systems.
- Understands the simulation and synthesis process and make advantage to debug the errors when developing and using the VLSI CAD tools.
- Able to develop a synthesis process in the VLSI CAD tools

UNIT I: VLSI DESIGN METHODOLOGIES

Introduction to VLSI Design methodologies - Review of Data structures and algorithms - Review of VLSI Design automation tools - Algorithmic Graph Theory and Computational Complexity - Tractable and Intractable problems - general purpose methods for combinatorial optimization.

UNIT II:DESIGN RULES

Layout Compaction - Design rules - problem formulation - algorithms for constraint graph compaction - placement and partitioning - Circuit representation - Placement algorithms - partitioning

UNIT III:FLOOR PLANNING

Floor planning concepts - shape functions and floorplan sizing - Types of local routing problems - Area routing - channel routing - global routing - algorithms for global routing.

UNIT IV:SIMULATION

Simulation - Gate-level modeling and simulation - Switch-level modeling and simulation - Combinational Logic Synthesis - Binary Decision Diagrams - Two Level Logic Synthesis.

UNIT V:MODELLING AND SYNTHESIS

High level Synthesis - Hardware models - Internal representation - Allocation assignment and scheduling - Simple scheduling algorithm - Assignment problem - High level transformations.

TEXTBOOKS:

S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.

N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.

EC4424 RF INTEGRATED CIRCUITS
Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

- To educate students fundamental RF circuit and system design skills.
- To introduce students, the basic transmission line theory, single and

multiport networks, RF component modelling.
- To offer students experience on designing matching and biasing networks & RF transistor amplifier design.

Course Outcomes:

- At the end of this course Students will learn:
- Understand the design bottlenecks specific to RF IC design, linearity related issues, ISI.
- Identify noise sources, develop noise models for the devices and systems.
- Specify noise and interference performance metrics like noise figure, IIP3 and different matching criteria.
- Comprehend different multiple access techniques, wireless standards and various transceiver architectures
- Design various constituents' blocks of RF receiver front end.

Unit I: INTRODUCTION TO RF AND WIRELESS TECHNOLOGY:

Complexity comparison, Design bottle necks, Applications, Analog and digital systems, Choice of Technology. BASIC CONCEPTS IN RF DESIGN: Nonlinearity and time variance, ISI, Random process and noise, sensitivity and dynamic range, passive impedance transformation.

Unit II: MULTIPLE ACCESS:

Techniques and wireless standards, mobile RF communication, FDMA, TDMA, CDMA, Wireless standards.

Unit III: TRANSCEIVER ARCHITECTURES:

General considerations, receiver architecture, Transmitter Architecture, transceiver performance tests, case studies.

Unit IV: AMPLIFIERS, MIXERS AND OSCILLATORS:

LNAs, down conversion mixers, Cascaded Stages, oscillators, Frequency synthesizers.

Unit V: POWER AMPLIFIERS:

General considerations, linear and nonlinear Pas, classification, High Frequency power amplifier, large signal impedance matching, linearization techniques.

Text Books:

BehzadRazavi, RF Microelectronics Prentice Hall of India, 2001

Thomas H. Lee, the Design of CMOS Radio Integrated Circuits, Cambridge University Press.

ECPE1_ FIBER OPTIC COMMUNICATION

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Introduction to vector nature of light, propagation of light, propagation of light ina cylindrical dielectric rod, Ray model, wave model.

Unit II:

Different types of optical fibers, Modal analysis of a step index fiber.

Signaldegradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

Unit III:

Optical sources - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detectorresponsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

Unit IV:

Optical switches - coupled mode analysis of directional couplers, electro-opticswitches.

Optical amplifiers - EDFA, Raman amplifier.

Unit V:

WDM and DWDM systems. Principles of WDM networks.

Nonlinear effects in fiber optic links. Concept of self-phase modulation, groupvelocity dispersion and solition based communication.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand the principles fiber-optic communication, the components and the bandwidth advantages.

Understand the properties of the optical fibers and optical components.

Understand operation of lasers, LEDs, and detectors

Analyze system performance of optical communication systems

Design optical networks and understand non-linear effects in optical fibers

EC4434 ANTENNAS AND WAVE PROPAGATION

Externals: 60Marks (L-T)-P-C

Internals: 40Marks 4-0-3

Course Objectives:

- Understand basic terminology and concepts of Antennas.
- To attain knowledge on the basic parameters those are considered in the antenna design process and the analysis while designing that.
- Analyze the electric and magnetic field emission from various basic antennas and
- mathematical Formulation of the analysis.
- To have knowledge on antenna operation and types as well as their usage in real time filed.
- Aware of the wave spectrum and respective band based antenna usage and also to know thepropagation of the waves at different frequencies through different layers in the existing layered free space environment structure.

Course Outcomes:

- Student will be able to:
- Aware of antenna parameter considerations
- Capable to analyze the designed antenna and field evaluation under various conditions andformulate the electric as well as magnetic fields equation set for far field and near field conditions
- Understand the array system of different antennas and field analysis under application of different currents to the individual antenna elements
- Understand the design issues, operation of fundamental antennas and their operation
- methodology in practice.
- Design a lens structure and also the bench set up for antenna parameter measurement of testingfor their effectiveness
- Knowledge about the means of propagation of electromagnetic waves

UNIT-I: Antenna Basics:

Introduction, Basic Antenna Parameters – Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Illustrative Problems. Fields fromOscillating Dipole, Field Zones, Front - to-back Ratio, Antenna Theorems, Radiation, Retarded Potentials – Helmholtz Theorem.Thin Linear Wire Antennas – Radiation from Small Electric Dipole, Quarter Wave Monopole and Half Wave Dipole – Current Distributions, Field Components, Radiated Power, Radiation Resistance, Beam Width, Directivity, Effective Area, Effective Height, Natural Current Distributions, Far Fields and Patterns of Thin Linear Centre-fed Antennas of Different Lengths, Illustrative Problems. Loop Antennas - Introduction, Small Loop, Comparison of Far Fields of Small Loop and Short Dipole, Radiation Resistances.

UNIT-II: Antenna Arrays:

Point Sources – Definition, Patterns, arrays of 2 Isotropic Sources - Different Cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, Endfire Arrays, EFA with Increased Directivity, Derivation of their Characteristics and Comparison, BSAs with Non-uniform Amplitude Distributions – General Considerations and Binomial Arrays, Illustrative Problems.

Antenna Measurements:Introduction, Concepts - Reciprocity, Near and Far Fields, Coordinate System Patterns to be Measured, Pattern Measurement Arrangement, Directivity Measurement, Gain Measurements (by Comparison, Absolute and 3- Antenna Methods)

UNIT-III: VHF, UHF and Microwave Antennas-I:

Arrays with Parasitic Elements, Yagi-Uda Array, Folded Dipoles and their Characteristics,Helical Antennas – Helical Geometry, Helix Modes, Practical Design Considerations for Monofilar Helical Antenna in Axial and Normal Modes, Horn Antennas – Types, Optimum Horns, Design Considerations of Pyramidal Horns, Illustrative Problems.

VHF, UHF and Microwave Antennas - II:

Microstrip Antennas – Introduction, Features, Advantages and Limitations, Rectangular Patch Antennas– Geometry and Parameters, Characteristics of Microstrip Antennas. Impact of Different Parameters on Characteristics, 103 Reflector Antennas – Introduction, Flar Sheet and Corner Reflectors, Paraboloidal Reflectors – Geometry, Pattern Characteristics, Feed Methods, Reflector Types – Related Features, Illustrative Problems. Lens Antennas – Introduction, Geometry of Non-metallic Dielectric Lenses, Fermat‘s Principle, Zoning, Applications.

UNIT-IV: Wave Propagation – I:

Introduction, Definitions, Categorizations and General Classifications, Different Modes of WavePropagation, Ray/Mode Concepts, Ground Wave Propagation (Qualitative Treatment) Introduction, Plane Earth Reflections, Space and Surface Waves, Wave Tilt, Curved Earth Reflections. Space Wave Propagation – Introduction, Field Strength Variation with Distance andHeight, Effect of Earth‘s Curvature, Absorption, Super Refraction, M-Curves and Duct Propagation, Scattering Phenomena, Tropospheric Propagation.

UNIT-V: Wave Propagation – II:

Sky Wave Propagation – Introduction, Structure of Ionosphere, Refraction and Reflectionof Sky Waves by Ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation between MUF and Skip Distance, Multihop Propagation.

TEXT BOOKS:

Antennas and Wave Propagation – J.D. Kraus, R.J. Marhefka and Ahmad S. Khan, TMH, New Delhi, 4thed., (Special Indian Edition), 2010.

Electromagnetic Waves and Radiating Systems – E.C. Jordan and K.G. Balmain, PHI, 2nd ed.2000.

A.Harish, M.Sachidanada," Antennas and Wave Propagation", Oxford University Press,2007

REFERENCES:

Antenna Theory - C.A. Balanis, John Wiley & Sons, 3rd Ed., 2005.

Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications,New Delhi,2001.

Transmission and Propagation – E.V.D. Glazier and H.R.L. Lamont, The Services Text Book of Radio,vol. 5, Standard Publishers Distributors, Delhi.

Antennas – John D. Kraus, McGraw-Hill (International Edition), 2nd Ed. 1988.

Electronic and Radio Engineering – F.E. Terman, McGraw-Hill, 4th edition, 1955.

ECPE1_ MICROWAVE THEORY AND TECHNIQUES

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Unit I:

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

Unit II:

Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line. Microwave Network Analysis- Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering Parameters.

Unit III:

Passive and Active Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Oscillators, Mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave Tubes: Klystron, TWT, Magnetron.

Unit IV:

Microwave Design Principles- Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power Amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design. Microwave Antennas- Antenna parameters, Antenna for ground based systems, Antennas for airborne and satellite borne systems, Planar Antennas. Microwave Measurements- Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of Microwave antenna parameters.

Unit V:

Microwave Systems- Radar, Terrestrial and Satellite Communication, Radio Aidsto Navigation, RFID, GPS. Modern Trends in Microwaves Engineering- Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

Understand various microwave system components their properties.

Appreciate that during analysis/ synthesis of microwave systems, the different mathematical treatment is required compared to general circuit analysis.

Design microwave systems for different practical application.

Text/Reference Books:

R.E. Collins, Microwave Circuits, McGraw Hill

K.C. Gupta and I.J. Bahl, Microwave Circuits, Artech house

EC4426 ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

Externals: 60Marks **(L-T)-P-C**

Internals: 40Marks **4-0-3**

Course Objectives:

This course provides

- An introduction to measurement techniques and instrumentation design and operation
- The basic concepts of units measurement error and accuracy, the construction and design of measuring devices and circuits measuring instruments and their proper applications
- To use different measuring techniques and measurement of different physical parameters using different transducers

Course Outcomes:

- Upon a successful completion of this course, the student will be able to:
- Describe the fundamental concepts and principles of instrumentation.
- Explain the operations of the various instruments required in measurements.
- Apply the measurement techniques for different types of tests.
- To select specific instrument for specific measurement function.
- Understand principle of operation, working of different electronic instruments like digital multi meter, vector voltmeter.
- Learners will apply knowledge of different oscilloscopes like CRO, DSO.
- Students will understand functioning, specification, and applications of signal analyzing instruments.

UNIT - I:

Block Schemantics of Measuring Systems: Performance characteristics, Static characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag; Measuring Instruments: DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of

Range, True RMS Responding Voltmeters, Specifications of Instruments.

UNIT - II:

Signal Analyzers: AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary waveform Generator, Video Signal Generators, and Specifications.

UNIT - III:

Oscilloscopes: CRT, Block Schemantic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Strorage Oscilloscopes, Digital Storage CROs.

UNIT - IV:

Transuducers: Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperatue sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

UNIT - V:

Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

Measurement of Physical Parameters: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure - High Pressure, Vacuum level, Temperature - Measurements, Data Acqisition Systems.

TEXTBOOKS:

Electronic instrumentation: H.S.Kalsi - TMH, 2nd Edition 2004.

Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI, 5th Edition, 2003.

REFERENCES:

Electronic Instrumentation and Measurements - David A. Bell, Oxford Uiv. Press, 1997.

Electronic Measurements and Instrumentation: B. M. Oliver, J. M. Cage TMH Reprint.

Measurement Systems - Emest O. Doebelin and Dhanesh N Manik, 6th Ed., TMH.

Electronic Measurements and Instrumentations by K. Lal Kishore, Pearson Education - 2010.

Industrial Instrumentation: T. R. Padmanabham Spiriger 2009.

SCHEME OF EVALUATION

Special Evaluation Pattern for the following courses:

S.NO.	Type of Course	Internals	Externals
1	HS1101: Communication Skills-I, HS1201: Communication Skills-II (Theory course)	Activities and Assignments = 40Marks	Written exam: 60Marks
2	HS1601: English Language Lab	Orals (50Marks)	Written exam: 50Marks
3	CE1001 (Engineering Graphics): (Course Type: Lab)	40	60

SCHEME OF EVALUATIO

Assessment Method		Description
Assignment & Continuous monitoring		Assignments drawings
Mid Term		2 mid ex conducted a considered.
End Term		Students wi on the ur principles, s the course

6	ECP03(3 credits Project),ECP04(8 credits project)	Three Internal Rev 60Marks
7	ECCV-I,ECCV-II (0 credit Comprehensive Viva)	NA

Evaluation Pattern for General Courses:

S.NO.	Type of Course	Internals	Externals
1	Theory	Best two out of Three MTs (2x15) + Assignments (10)= 40Marks	60Marks
2	Lab	(Report+Record) (20)+ Attendance(10) + Internal Viva (10)= 40 Marks	Lab Experiment (40) + External Viva (20) = 60 Marks
3	EC2901,EC2902, EC3901 (1 credit Mini project, 1 credit Technical seminar)	NA	100Marks
4	ECP01 (2 credits Mini project)	Mid-Sem review (40 Marks)	End-Sem review (60 Marks)
5	ECP02 (1 credit Summer Internship)	Industry Expert (30 Marks) + RGUKT panel (70 Marks)	

RGUKT_EEE_Curriculum@2019-20

I SEMESTER

S.No.	Course Code	Course Title	Course Category	Hours per week L	T	P	Total Contact Hours	Credits
1	MA1101	Linear algebra and Calculus	BSC	4	0	0	4	4
2	PH1105	Engineering Physics	BSC	3	1	0	4	4
3	PH1605	Engineering Physics Lab	BSC	0	0	3	3	1.5
4	HS1101	English	HSMC	2	0	0	2	2
5	HS1701	English Language Lab	HSMC	0	0	2	2	1
6	CE1701	Engineering Graphics	ESC	0	0	6	6	3
7	CS1101	Pragramming for Problem Solving	ESC	3	0	0	3	3
8	CS1701	Pragramming for Problem Solving Lab	ESC	0	0	4	4	2
Total				12	1	15	28	20.5
Induction Programme (Non-Credit)								

MA1101 **MATHEMATICS – I**

(LINEARALGEBRA AND CALCULUS)

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **4-0-0-4**

Course Objectives:

- Types of matrices and their properties.
- Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
- Concept of Eigen values and Eigen vectors and to reduce the quadratic form to canonical form.
- Concept of Sequence.
- Concept of nature of series.
- Geometrical approach to the mean values theorems and their application to the mathematical problems.
- Evaluation of surface areas and volumes of revolutions of curves.
- Evaluation of improper integrals using Beta and Gamma functions.
- Partial differentiation, concept of total derivative.
- Finding maxima and minima of function of two and three variables.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Write the matrix representation of set of linear equations and to analyze the solution of the system of equations.
- Find the Eigen values and Eigen vectors.
- Reduce the quadratic form to canonical form using orthogonal transformations.
- Analyze the nature of sequence and series.
- Solve the applications on the mean value theorems.
- Evaluate the improper integrals using Beta and Gamma functions.
- Find the extreme values of functions of two variables with/without constraints.

UNIT-I: Matrix Theory

Types of Matrices, Symmetric, Hermitian, Skew-Symmetry, Skew-Hermitian, Orthogonal matrices, Unitary matrices; Elementary row and column operations on a matrix, Rank of a matrix by Echelon form and Normal form, Inverse of a Non-singular matrix by Gauss-Jordan method; Consistency and solutions of system of linear equations using elementary operations, Gauss elimination method; Gauss Seidel Iteration method.

UNIT-II: Eigen values and Eigen vectors

Linear Transformation and Orthogonal Transformation; Characteristic roots and vectors of a matrix; Diagonalization of a matrix; Cayley-Hamilton theorem(without proof) ; finding inverse and power of a matrix by Caylay-Hamilton Theorem; Quadratic forms and Nature of the Quadratic forms; Reduction of quadratic form to canonical form by Orthogonal transformation.

UNIT-III: Sequences & Series:

Definition of a sequence, limit; Convergent, Divergent and Oscillatory sequences. Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test; Logarithmic test. Alternating series; Leibnitz test; Alternating Convergent series; Absolute and conditionally convergence.

UNIT-IV: Calculus:

Mean value theorems: Roll's theorem, Lagrange's Mean value theorem, Cauchy's Mean value theorem; Taylor's and Macaurin's series with remainders, Expansions; Applications of definite integrals to evaluate surface area and volumes of revolutions of curves (Only in Cartesian coordinates): Definition of Improper Integrals and their convergence, Beta and Gamma functions and their applications.

UNIT-V: Multivariable Calculus (Partial Differentiation and applications):

Definitions of Limits and continuity. Partial Differentiation; Euler's theorem; Total Derivative; Jacobian; Functional dependence and independence; Maxima and minima of functions of several variables (two and three variables) using Lagrange Multipliers.

Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons, 8th Edition,
2. R.K.Jain and S.R.K.Iyengar Advanced Engineering Mathematics, Narosa Publications House.2008
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publications, 2009.

References:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint,2002.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010.
3. N.P. bail and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint,2008.

PH1105 **ENGINEERING PHYSICS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-1-0-4**

UNIT I : Vectors and Mathematical Physics (5 hours)

Gradient, Divergence, Curl and its applications .Line, surface and volume integrals, Stokes and Gauss theorem, Curvilinear Coordinates: Polar, Cylindrical and spherical polar co-ordinates, Problems

UNIT II : Electromagnetic Theory (18 hours)

Electrostatics in linear medium
Physical Interpretation of Bound charges & Electric displacements, Boundary conditions of displacements and Linear dielectrics ,Potential at the centre of a metal sphere surrounded by linear dielectrics
Magneto statics in linear magnetic linear medium
Magnetization and associated bound currents, auxiliary magnetic fields, Boundary conditions on B and H
UNIT – III: Maxwell's Equations

Continuity equation for current density; modifying equation for curl of magnetic field to satisfy continuity equation, Displace current and magnetic field arising from time dependent electric field, Maxwell's equation in vacuum and non- conducting medium; Energy in an electromagnetic fields. Flow of energy and Poynting vector & Qualitative discussion of momentum in electromagnetic fields.

UNIT – IV: Electromagnetic waves

The wave Equation; Plane electromagnetic waves in vacuum. Polarization; relation between electric and magnetic fields of electromagnetic waves. Energy carried by electromagnetic waves and examples. Momentum carried by electromagnetic waves and pressure. EM waves in vacuum: propagation in linear media, boundary conditions , Reflection and transmission co-efficient of electromagnetic waves from a non conducting medium- vacuum interface for normal incidence. Problems

UNIT V: Quantum Mechanics (5 hours)

Introduction to Quantum Mechanics, De-Brogile waves and uncertainity principle, Time dependant Schrodinger wave equation, Significance of Wave Function, Time independent Schrodinger wave equation and solution of generalized potential, Particle in a box, Problems.

UNIT VI: Electron Structure of solids (6 hours)

Introduction to Crystallography, Bravais Lattices, Miller Indices, Free electron Theory, Kronig Penny model (E vs K), Band theory of solids

UNIT VII: Semiconductor Physics (6)

Intrinsic and extrinsic semiconductors, Fermi level and carrier-concentration, Effect of temperature on Fermi level.Mobility of charge carriers and effect of temperature on mobility, Hall Effect, Energy band gap determination of semiconductors by four probe method, Direct and Indirect Bandgap semiconductors .

Reference books:

1. Arfken, Mathematical Physics
2. David Griffiths, Introduction to Electrodynamics &W Saslow, Electricity, Magnetism and Light
3. David Griffiths, Quantum Mechanics
4. Wahab, Solid State Physics
5. S M Sze, Semiconductor Devices: Physics and Technology, Wiley (2008)

PH1605 **Engineering Physics Lab**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-3-1.5**

List of Experiments:

1. Four Probe Method
2. Hall Effect
3. Dielectric Constant
4. Frank Hertz Experiment
5. Diffraction Grating
6. Ultrasonic Interfeometer
7. Energy Bandgap of a semiconductor
8. Photoelectric Effect
9. Torsional Pendulum
10. Magnetic Hysterisis Curve

HS1101 **English**

Externals: 60 Marks **L-T-P-C***

Internals: 40 Marks **4-0-0-3**

Course Objectives:

* To complement the comprehensibility of the Technical subjects in a better way.
* To make them competent to attempt and qualify in various tests.
* To develop the study skills in formal and informal situations.

Course Outcomes:

Students will be able

* To learn the impacts of technology on language and personal life.
* To pronounce better and enhance their reference skills.

* To appreciate the aesthetic understanding and pleasure reading.
* To improve analysis skills through movies.
* To strengthen public speaking skills.
* To refine their comprehensive writing skills

UNIT-I
A Road Not Taken by Robert Frost: Understanding the Poem- Importance of the poem – Figures of Speech –Simile- Metaphor- Alliteration- Onomatopoeia - Invictus (2009)

UNIT-II
Phonetics: Commonly Mispronounced Words - Consonants - Vowels – Voiced & voiceless - BBC Phonetic Transcription – Syllabification - Word Stress - Tongue Twisters – The King's Speech (2010) – My Fair Lady (1968)

UNIT-III
What's Up? An Excerpt from The Hindu (September 29, 2015) – Binomials and Portmanteau - Common errors in English Usage

UNIT-IV
Malala's Speech: An Excerpt from www.noble.org (10 December 2014): Self-Introduction - One Word Substitutes - Homophones, Homonyms and Homographs - Debate - Group Discussion – Girl Rising (2013)

UNIT-V
The Nightingale and the Rose by Oscar Wilde: - Skimming and Scanning - Dialogue writing: Seeking Permission, Requesting, and Interrupting – Tangled (2010)

UNIT –VI
Anand's Super 30 for IIT - JEE : An Excerpt from The India Today (July 11,15): Letter Writing - Formal Letter - Informal Letter - Notice Writing - Email writing – Freedom Writers (2007)

UNIT –VII
Education and Technology - Burj Khalifa : www.natgeotv.com : Burj Khalifa (Documentary Video)- JAM/PPT Presentations - Essay Writing

UNIT –VIII
A Missile Man – Dr. APJ Kalam: An Excerpt from The Hindu (Sept 25, 2006) – Interviews - Curriculum Vitae or Resume preparation – I am Kalam (2010)
FURTHER STUDIES (SELF STUDY): U-I: Capitalization, Punctuation (commas, full stop,

inverted marks) - U-II: Words often Confused, Affixes (Prefixes and Suffixes), Commonly Mispronounced Words, Tongue Twisters - U-III: Articles - Prepositions, Spotting the Error –

UIV: Index –Grammar (Additional Information)
Tenses – U-V: Active and Passive, Direct and Indirect Speech – U-VI: Understanding the rules of spelling Part1&2 – U-VII: Commonly Used Phrasal Verbs & Idioms – U-VIII: Antonyms and synonyms

Suggested References:

1. Meenakshi Raman, Sangeetha Sharma. "***Effective Technical Communication***." Oxford: Oxford University, New Delhi, 2015.
2. Murali Krishna, ***"English for Engineers."*** Pearson Education, Inc. New Delhi, 2015.
3. 3. E. Suresh Kumar, P. Sreehari and J. Savithi**.** ***"English for Success."*** Foundation Books, Inc. New Delhi, 2014.
4. 4. Ashraf. M. Rizvi, ***"Effective Technical Communication."*** Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2015.
5. 5. Hari Mohan Prasad and Rajnish Mohan, ***"How to prepare for Group for Group Discussion and Interview."*** 2nd Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2015.
6. 6. R.P Bhatnagar and Bhargava Rajal, ***"English for Competitive Examinations".*** McMillan India limited, 1989.
7. 7. Upendran. S, ***"Foundation Course in Spoken English Part I".*** McMillan India limited, 1989.
8. 8. Upendran. S, ***"Foundation Course in Spoken English Part II".*** McMillan India limited,1989.

Web sources:
1. www.usingenglish.com
2. www.talkenglish.com
3. www.oxforduniversity.com
4. www.wikipedia.com
5. www.about.com

For Literature:
1. www.cliffsnotes.com
2. www.sparksnotes.com
3. www.gradesaver.com
4. www.nofearshakespeare.com

HS1701 **English Language Lab**
Externals: 60 Marks **L-T-P-C***

Internals: 40 Marks **0-0-3-2**

Course Objectives:

* To sensitize students to their communication skills.
* To make the students practice the language skills (L, S, R, W).

Course Outcomes:

* Students will be able to write essays and paragraphs that demonstrate proper usage of grammar.
* Students will demonstrate the ability to critique their grammar assignments.
* Students will be able to assess their pronunciation of words.
* Students will analyze the forms of different expressions in English Language that reflect the individual, social, and cultural values.
* Students will demonstrate the proficiency in oral and written communication.

UNIT-I

Grammar – Adjectives – Comparatives and Superlatives – Adverbs – Countable and Uncountable Nouns – Pronouns – Simple present – Present continuous – Simple past- Conjunctions – Prepositions – Plurals – Articles a, an, the – Infinitive or –ing – Questions and Negatives -1 - Questions and Negatives -2

UNIT-II

Pronunciation – Pill/Fill – Buy/My – Tie/Die – Ship/Chip – Yet/ Jet – Game/ Came – Wail/Veil – Think/Sink – There/Dare – Price/ Prize – Asia/ Hard – Ran/Rang – Right/Light – Ship/Sheep – Head/Had- Schwa – Luck/ Look - Hat/Heart – But/Boot – Who/ Her – Pot/Port – Hair/ Hear – Pay/Pie – Boy/Buy – Know/ Now

UNIT-III

Writing – Writing a Thank You Letter – Writing about your life – Writing Instructions – Writing a Story – Writing an Essay – Writing a Business Letter – Writing a Film Review – Writing a Biography – Writing a Complaint Letter – Writing a Covering Letter - Writing a Pen friend Post - Writing about a Special Day - Writing an E-mail of Apology - Writing a Short Report - Writing a Post Card

UNIT – IV

Reading - The diamond thief – The guru and sweets – Taking a course – Reading a story - Using a dictionary – Making a journey – Reading a newspaper – Making friends – Reading an email – Finding information – A pen friend letter – The doctor says…- Choosing a holiday – Struck by lightning – Health matters :Yoga

UNIT – V

Listening – What shall we play? – An exciting weekend – A school outing – The morning assembly – Instructions on planting – Excuse me, can you lend me…- Manish's summer – Vignesh's hobby – What can I do for you? – What are you doing Ramesh? – I've got a few questions…- Geetha's day – Anil's new purchase – What are we having tonight? – What is the problem?

Suggested References:

1. Clarity English Success - Software
2. http://www.clarityenglish.com/program/practicalwriting/
3. http://www.clarityenglish.com/program/roadtoielts/
4. http://www.clarityenglish.com/program/clearpronunciation1/
5. http://www.clarityenglish.com/program/resultsmanager/

CE1701 **ENGINEERING GRAPHICS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **1-0-4-3**

Course Objectives:

- To introduce the students to the "Universal Language of Engineers" for effective communication through drawing.
- To understand the basic concepts of drawing through modern techniques.
- To impart knowledge about standard principles of projection of objects.
- To provide the visual aspects of Engineering drawing using Auto-CAD.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Use Engineering principles and techniques to understand and interpret engineering drawings.
- Understand the concepts of Auto-CAD.
- Draw orthographic projections of lines, planes and solids using Auto-CAD.
- Use the techniques, skills and modern engineering tools necessary for engineering practices.

UNIT-I:Introduction to Engineering Drawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, types of lines and Dimensioning. *Over view of Auto-CAD:* Theory of CAD software (The Menu System, Tool Bars, Drawing area, Dialogue boxes, Shortcut Menu, the command lines, Select and erase objects, Introduction to layers etc.), Drawing simple figures- lines, planes, solids.

UNIT-II:

Geometrical constructions: Construction of regular polygons.
Conic sections: Construction of Ellipse, Parabola, Hyperbola (General method only), Cycloid, Epicycloid, Hypocycloid and Involutes.
Scales: Construction of Plain, Diagonal and Vernier scales.
UNIT-III

Orthographic projections: Principles of Orthographic Projections
Projections of Points: Projections of Points placed in different quadrants,
Projection of lines: lines parallel and inclined to both the planes (Determination of true lengths and true inclinations and traces)
Projection of planes: Planes inclined to both the reference planes

UNIT-V

Development of surfaces: .Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone ,
Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views of planes and simple solids,
Perspective projections: Basic concepts of perspective views.

Text/Reference Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age publications
5. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
6. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
7. (Corresponding set of) CAD Software Theory and User Manuals

CS 1101 PROGRAMMING FOR PROBLEM SOLVING
Externals: 60Marks **L-T-P-C***
Internals: 40Marks **4-0-0-4**

Prerequisites

1. No prerequisites

Course Objectives

* Requires analytical skills and logical reasoning.
* This course starts from the basics of computers and program development.
* It introduces searching and sorting algorithms

Course Outcomes

* Develop C programs for computing and real life applications using basic elements like control statements, arrays, functions, pointers and strings and Implement searching and sorting algorithms

UNIT – I

Introduction to Computer Programming: Computing Environments, Computer Languages, Creating and Running Programs. Algorithm and Flow charts. Introduction to C Language syntax.

UNIT-II

Selection: Logical Data and Operators, if-else, switch Statements, Standard Functions. Repetition: loops, while, for, do-while statements, break, continue. Arrays and its applications in searching and sorting. Strings and string manipulation functions.

UNIT – III

Functions: Designing Structured Programs, Functions Basics, User Defined Functions, Inter Function Communication, Standard Functions, Scope, Storage Classes, Scope Rules, and Type Qualifiers. Recursion

UNIT – IV

Pointers, pointers to arrays, pointers as arguments and dynamic memory allocation.

UNIT – V

Structures, unions, file input and output.

<u>Text book:</u>

1. C Programming & Data Structures, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.
2. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, Fifth Edition, Pearson Education.
3. The C Programming Language, B.W. Kernighan and Dennis M.Ritchie, PHI/Pearson Education

CS1701 PROGRAMMING FOR PROBLEM SOLVING LAB

Externals: 60Marks **L-T-P-C***

Internals: 40Marks **0-0-3-2**

Course Objectives:

- Able to have fundamental concept on basics commands in Linux.
- Able to write, compile and debug programs in C language.

- Able to formulate problems and implement algorithms in C.

- Able to effectively choose programming components that efficiently solve computing problems in real-world

Experiments:
Suggested assignments to be conducted on a 3-hour slot. It will be conducted in tandem with the theory course so that the topics for problems given in the lab are already initiated in the theory class. The topics taught in the theory course should be appropriately sequenced for synchronization with the laboratory. A sample sequence of topics and lab classes for the topic are given below:

1. Familiarization of a computer and the environment and execution of sample programs
2. Expression evaluation
3. Conditionals and branching
4. Iteration
5. Functions
6. Recursion
7. Arrays
8. Structures
9. Files

For the detailed list of programs refer the lab manual.

Note: Any experiment according to the syllabus of CS1101 can be substituted

II SEMESTER

S.No.	Course Code	Course Title	Course Category	Hours per week L	T	P	Total Contact Hours	Credits
1	EE1201	Electrical Circuit Analysis	PCC	4	1	0	5	5
2	EE1801	Electrical Circuit Analysis Lab	PCC	0	0	2	2	1
3	MA1202	Differential equations and Laplace Transforms	BSC	3	1	0	4	4
4	CY1001	Chemistry	BSC	3	1	0	4	4
5	CY1601	Chemistry Lab	BSC	0	0	3	3	1.5
6	ME1203	Workshop/Manufacturing Practices	ESC	2	0	2	4	3
7		Constitution of India	MC	2	0	0	2	2
8	MC1002	Environmental Science	MC	2	0	2	4	3
		Total		16	3	9	28	23.5

EE1201 **ELECTRICAL CIRCUIT ANALYSIS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **4-1-0-5**

Course Objectives:

- To introduce the basic concepts of circuit analysis which is the foundation for all subjects of the Electrical Engineering discipline.
- To introduce the various techniques/tools used in the transient and steady-state response of electrical circuits.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Apply network theorems for the analysis of electrical circuits.
- Obtain the transient and steady-state response of electrical circuits.
- Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).
- Analyse two port circuit behavior.

UNIT I : Circuits Analysis (12 hours)

DC Circuits: Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation, Network reduction techniques (Series, Parallel connection, Star-delta transformation), Analysis with dependent current and voltage sources. Nodal and Mesh Analysis.
Network Theorems: Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Tellegen's Theorem, Milliman's Theorem

UNIT II: Sinusoidal steady state analysis (12 Hours)

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, reactive power, apparent power, power factor average power and complex power. . Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance: series and parallel resonances, Superposition theorem, Thevenin's theorem, Norton theorem, Maximum power transfer theorem
Three phase balanced circuits, voltage and current relations in star and delta connection, Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

UNIT III: Solution of First and Second order networks (10 Hours)

Solution of first and second order differential equations for Series and parallel R-L, R-C, R-L-C circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

UNIT IV: Electrical Circuit Analysis Using Laplace Transforms (10 Hours)

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots)

UNIT V: Two Port Network and Network Functions (12 Hours)

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks,
Network Topology: Definitions – Graph – Tree, Basic Cutset and Basic Tieset Matrices for Planar Networks – Loop and Nodal Methods of Analysis of Networks with Dependent & Independent Voltage and Current Sources – Duality & Dual Networks.

Text Books:

1. M. E. Van Valkenburg, “ Network Analysis” , Prentice Hall, 2006.
2. D. Roy Choudhury, “ Networks and Systems”, New Age International Publications, 1998.
3. W. H. Hayt and J. E. Kemmerly, “ Engineering Circuit Analysis” , McGraw Hill Education, 2013.
4. Network Theory by N.C.Jagan & C.Lakshminarayana, B.S. Publications.
5. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.

Reference Books:

1. C. K. Alexander and M. N. O. Sadiku, “ Electric Circuits”, McGraw Hill Education, 2004.
2. K. V. V. Murthy and M. S. Kamath, “ Basic Circuit Analysis” , Jaico Publishers, 1999.
3. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.

EE1801 **ELECTRICAL CIRCUIT ANALYSIS LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objective:

- To expose the students to the concepts of electrical and electronics circuits and give them experimental skills.

Course Outcomes: Upon completion of this course

- The student will be able to perform experiments to verify network theorems
- Understand the usage of common electrical measuring instruments.
- The student will be able to perform experiments to study transient and steady state behavior of electrical circuits for DC and Sinusoidal excitation
- The student will be able to perform experiments to determine the two port network parameters

List of Experiments:

1. Introduction Lab
   (i) Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
   (ii) Verification of Ohm's Law, KCL and KVL
2. Measuring the steady-state and transient time-response of R-L and R-C to a step change in voltage (transient may be observed on a storage oscilloscope).
3. Measuring the steady-state and transient time-response of R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope).
4. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage.
5. Resonance in R-L-C circuits.
6. Verification of Superposition theorem and Reciprocity theorem
7. Verification of Thevenin's theorem and Maximum power transfer theorem
8. Determination of 2-port parameters for a given network: Z,Y, ABCD parameters

Any two of the following simulation experiments

1. Simulation of DC Circuits
2. DC Transient response
3. Mesh Analysis
4. Nodal Analysis

MA1202	**Mathematics-II** (Differential Equations and Laplace Transforms)	
Externals: 60Marks		**L-T-P-C**
Internals: 40Marks		**3-1-0-4**

Course Objectives:

- Methods of solving the differential equations of first and higher order.
- To study the methods of solving improper integrals and the concepts of multiple integrals
- The basic properties of vector valued functions and their applications to line, surface an volume integrals
- To study numerical methods to analyze an experimental data.

Course Outcomes: At the end of the course student will be able to

- Solve first order linear differential equations and special non linear first order equations like Bernouli , Riccati & Clairaut’s equations
- Compute double integrals over rectangles and type I and II" regions in the plane
- Explain the concept of a vector field and make sketches of simple vector fields in the plane.
- Explain concept of a conservative vector field, state and apply theorems that give necessary and sufficient conditions for when a vector field is conservative, and describe applications to physics.
- Recognize the statements of Stokes' Theorem and the Divergence Theorem and understand how they are generalizations of the Fundamental Theorem of Calculus.
- Able to solve the problems in diverse fields in engineering science using numerical methods.

UNIT-I: Ordinary Differential Equations of first order

Exact first order differential equation, finding integrating factors, linear differential equations, Bernoulli's , Riccati , Clairaut’s differential equations, finding orthogonal trajectory of family of curves, Newton’s Law of Cooling, Law of Natural growth or decay

UNIT-II: Ordinary Differential Equations of higher order

Linear dependence and independence of functions, Wronskian of n- functions to determine Linear Independence and dependence of functions, Solutions of Second and higher order differential equations (homogeneous & non-homogeneous) with constant coefficients, Method of variation of parameters, Euler-Cauchy equation.

UNIT-III: Laplace Transform –I:

Definition of Laplace Transform, linearity property, conditions for existence of Laplace Transform. First and second shifting properties, Laplace Transform of derivatives and integrals, unit step functions, Dirac delta-function, error function. Differentiation and integration of transforms, convolution theorem.

UNIT-IV Laplace Transform –II:

Finding Inverse Laplace Transform using various methods, Evaluation of integrals by Laplace Transform. Solving initial and boundary value problems, Differential Equations & Partial differential equations, Integral Equations using Laplace Transforms.

UNIT-V: Integral Calculus

Convergence of improper integrals, tests of convergence, Beta and Gamma functions

1. elementary properties, differentiation under integral sign, differentiation of integrals with variable limits
2. Leibnitz rule. Rectification, double and triple integrals, computations of surface and volumes, change of variables in double integrals - Jacobians of transformations, integrals dependent on parameters – applications.

Text Books:

1. Advanced Engineering Mathematics (3rd Edition) by R. K. Jain and S. R. K. Iyengar, Narosa Publishing House, New Delhi

References Books:

1. Advanced Engineering Mathematics (8th Edition) by Erwin Kreyszig, Wiley-India.
2. Dr.M.D.Raisinghania,OrdinaryandPartialdifferentialequations,S.CHAND,17thEdition2014.

CHEMISTRY

CY1001

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-1-0-4**

Unit 1: Spectroscopy (7 hours):

Introduction to spectroscopy, electromagnetic radiations, different types of spectroscopy, principle of spectroscopy, spectrophotometer Microwave spectroscopy: principle, microwave spectra of diatomic molecules, selection rules for microwave spectra, applications of microwave spectroscopy: determination of bond length, dipole moment measurement, determination of isotopic mass of an element. Infrared spectroscopy: introduction and principles of IR, types of vibrations: bending and stretching, Hooke's law for stretching vibrations, characteristic frequencies of common functional groups, IR instrumentation, interpretation and applications of IR spectrum with examples.

Ultra-violet spectroscopy: Introduction and principle of UV spectroscopy, color interpretation with VBT and MOT, types of electronic transitions, selection rules, chromophores and auxochromes with examples, conjugation effect, absorption and intensity shifts, applications of UV spectroscopy.

Unit 2: Chemical kinetics (6 hours)

Complex reactions: definition and classification of complex reactions, definition of reversible reactions with examples, rate law derivation for reversible reactions.
Consecutive reactions:definition, rate law derivation and examples of consecutive reactions.
Parallel reactions: definition, rate law derivation and examples of parallel reactions.
Steady-state approximation: introduction, kinetic rate law derivation by applying steady state approximation in case of the oxidation of NO and pyrolysis of methane.
Chain reactions: introduction, types and mechanism of chain reactions, stationary and non-stationary chain reactions with examples, deriving the kinetic rate equation using a general chain reaction.
Photochemical reactions: introduction, Stark-Einstein law of photochemical equivalence, photophysical processes: IC, ISC, fluorescence and phosphorescence with examples, kinetic rate law derivation incase of photochemical decomposition of HI and photochemical combination of H_2 and Br_2.

UNIT 3: Electrochemistry (8 hours)

Types of electrodes: introduction, metal-metal ion electrodes, metal-insoluble salt-anion electrodes, calomel electrode, gas-ion electrodes, hydrogen and chlorine electrodes, oxidation-

reduction electrodes, amalgam electrodes.
Types of cells: classification into chemical and concentration cells, chemical cells with transference and without transference, classification of concentration cells into electrolyte and electrode concentration cells, electrolyte concentration cells with and without transference, amalgam and gas concentration cells, examples for these cells.
EMF and applications of EMF: determination of pH, determination of the valency of the ions,potentiometric titrations. pH: definition of pH and determination of pH by various methods, acid-base titrations.
Thermodynamic data:enthalpy and entropy of cell reactions, Gibbs-Helmholtz equation and applications.

Unit 4: Corrosion and its prevention (4 hours)

Mechanism of Dry and wet corrosion (rusting of iron), Types of corrosion, galvanic corrosion, stress corrosion, pitting and crevice corrosion. Factors affecting corrosion, preventive measures (proper design, Cathodic and Anodic protection, Electroplating , tinning, galvanizing.

Unit 5: Organic reactions and synthesis of a drug molecule (8 hours)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecules like Aspirin, Ibuprofen.

Unit 6: Phase Rule (4-hours)

Terminology, One component system (H_2O system, S- system and CO_2 – system), two components system, Cooling curves, simple eutectic system (Pb – Ag), system with congruent melting point (Zn – Mg).

Unit 7: Engineering Materials: (7 hours)

Polymers: Types of Polymerization (Chain & Step growth).Plastics: Thermoplastic & Thermo setting resins; Preparation, properties,engineering applications of PVC, Teflon and Bakelite.
Lubricants: Classification with examples-Characterstics of a good lubricant & mechanism of lubrication (thick film , thin film and extreme pressure) –properties of lubricants: viscosity , Cloud point, flash and fire points.
Refractoriness: Classification, characteristics of a good refractory and applications.
Nanomaterials: Introduction, preparation by sol-gel & chemical vapour deposition methods.Applications of nanomaterials.

Refer Books:

1. Engineering Chemistry, Jain & Jain
2. Engineering Chemistry, Shashi Chawla
3. Chemistry for Engineers, B. K. Ambasta
4. Engineering Chemistry, H. C. Srivastava

CY1601 **CHEMISTRY LAB**

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **0-0-3-2**

Course Objectives:

* To learn the preparation of organic compounds in the laboratory
* To estimate the hardness and alkalinity of the given sample of water
* To understand the Job's method for determining the composition
* Learns how to use the pH meter and polarimeter

Course Outcomes_;

* Minimum knowledge on basic synthesis, quantitative and qualitative analysis is being imparted
* **Synthesis**
* Synthesis of soap from cheap oil.
* Synthesis of Thiokol rubber

* **Volumetric analysis**
* Estimation of alkalinity of water
* Estimation of total hardness of water by EDTA method

* **Job's method**
* Determination of composition of Ferric-Thiocyanate complex by Job's method

* **pH meter**
* Estimation of the strength of a weak acid by pH metry

* **Polarimeter**
* Determination of specific rotation of sucrose by polarimeter

Reference books:

1. College Practical Chemistry by V K Ahluwalia, Sunita Dhingra, Adarsh Gulati
2. Practical Engineering Chemistry by K Mukkanti
3. A Text Book of Engineering Chemistry: by Shashi Chawla
4. Essentials of Experimental Engineering Chemistry by Shashi Chawla
5. Comprehensive Practical Organic Chemistry – Preparation and Quantitative analysis byV K Ahluwalia, Renu Aggarwal

ME1203 WORKSHOP/MANUFACTURING PRACTICES

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**1-0-4-3**

(i)Theory

Course Objectives:

- To understand basic concepts of fitting, carpentry and House wiring.
- To understand the basic manufacturing process of producing a component by casting, plastic molding and joining processes.
- To understand machining of a component either by conventional or by unconventional processes.
- To understand the concepts of plastic deformation and the processes involved in manufacturing through forming process.
- To understand the advanced manufacturing process of additive manufacturing process.

Course Outcome:

- Students will gain knowledge of the different manufacturing processes which are commonly employed in the industry, to fabricate components using different materials.

UNIT – 1: Fitting operations and tools.

UNIT – 2: Carpentry and tools

UNIT – 3: Electrical House wiring.

UNIT – 4: Metal Casting

Introduction, Tools, Types of Patterns, Pattern Materials, Types of casting – Sand, Die and other casting processes and Applications

UNIT – 5: Plastic molding and Glass cutting

UNIT – 6: Joining

Types of Joining, Introduction to Welding, Brazing and soldering, Arc and gas welding.

UNIT – 7: Conventional Machining processes: Introduction to machining operations; Lathe operations, Drilling, Milling and Grinding.

UNIT – 8: Unconventional Machining processes: ECM, EDM, AJM and USM.

UNIT – 9: Metal Forming: Introduction, Classification, Types of Bulk and sheet metal forming and Applications.

UNIT – 10: Additive manufacturing

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.

2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.

Reference Books:

1. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.

2. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

3. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGrawHill House, 2017.

(ii) Workshop Practice
Course Outcomes:

- Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
- They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
- By assembling different components, they will be able to produce small devices of their interest.

Practical's (30 Hrs):

1. Fitting shop (6 hours)
2. Carpentry (4 hours)
3. Electrical & Electronics (4 hours)
4. Smithy (2 hours)
5. Welding shop (4 hours) (Arc welding 2 hrs + gas welding 2 hrs)
6. Casting (2 hours)

7. Machine shop (6 hours)
8. Plastic molding & Glass Cutting (2 hours)

MC1002 ENVIRONMENTAL SCIENCES

Externals: 60 Marks **L-T-P-C**
Internals: 40 Marks **4-0-0-3**

Course Objectives:

- To study the sources of water,floods and its impact on environment
- To know about the ecosystem and energy resource system
- To understand the Biodiversity concept and its advantages
- To study different types of pollution and its impact on environment
- To know the social and environment related issues and their preventive measures

Course Outcomes

- To get the idea about the relation between biotic and abiotic environment in nature
- To get the idea about the nature and the pollutants
- To get opportunity to know the value of bio diversity and threats of bio diversity
- To know about the conservation of biodiversity
- Ability to know the environmental impact

Unit - I

Environmental studies: Definition, scope and importance, need for public awareness.

Natural resources: Water resources; use and over utilization of surface and ground water, Floods, drought, conflicts over water, dams-benefits and problems. Effects of modern Agriculture, fertilizer-pesticide problems, water logging and salinity.

Unit - II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, producers, consumers and decomposers, energy flow in ecosystem, food chains, ecological pyramids, aquatic ecosystem(ponds, streams, lakes, rivers, oceans, estuaries).

Energy resources: Growing energy needs renewable and non-renewable energy sources.

Land resources.land as resource, land degradation, soil erosion and desertification.

Unit - III

Biodiversity: Genetic species and ecosystem diversity, bio-geographical classification of India. Value of biodiversity, threats to biodiversity, endangered and endemic species of India, conservation of biodiversity.

Unit - IV

Environmental pollution: Causes, effects and control measures of air pollution, water pollution, soil pollution, noise pollution, thermal pollution and solid and liquid waste management.
Environment protection act: Air, water, forest and wild life Acts, enforcement of Environmental legislation.

Unit - V

Social Issues and the Environment: Water conservation, watershed management, and environmental ethics. Climate change, global warming, acid rain, ozone layer depletion.
Environmental Disaster management: Types of disasters, impact of disasters on environment, infrastructure, and development. Basic principles of disaster mitigation, disaster management, and methodology, disaster management cycle, and disaster management in India.

Suggested readings:

1. A.K De, Environmental Chemistry,Wiley Eastern Ltd.
2. E.P. Odum, Fundamentals of Ecology,W.B. Sunders Co., USA.
3. M.N, Rao and A.K. Datta, Waste Water Treatment Oxford and IBK Publications.
4.Benny Joseph, Environmental Studies, Tata McGraw Hill, 2005.
5. V.K. Sharma, Disaster Management, National Centre for Disaster Management, IIPE, Delhi, 1999.

Reference:

1. Green Buildings Council of India, Teri Document.
2. GL. Karia and R.A. Christian, Waste Water Treatment, Concepts and Design Approach, Prentice Hall of Indian, 2005

III SEMESTER

S.No.	Course Code	Course Title	Course Category	Hours per week L	T	P	Total Contact Hours	Credits
1	EE2101	Electrical Machines-I	PCC	3	0	0	3	3
2	EE2102	Analog Electronic Circuits	PCC	4	1	0	5	5
3	EE2103	Electromagnetic Fields	PCC	3	1	0	4	4
4	EE2701	Analog Electronic Circuits Lab	PCC	0	0	2	2	1
5	ME2104	Engineering Mechanics	ESC	3	1	0	4	4
6	MA2105	Vector Calculus and Complex analysis	BSC	3	1	0	4	4
7	HS2101	Essence of Indian Traditional Knowledge	MC	2	0	0	2	2
Total				18	4	2	24	23

EE2101 ELECTRICAL MACHINES-I

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

This course introduces the concept of

- Construction operational features of energy conversion devices i.e., DC machines and transformers.
- Characteristics of DC machines and transformers and their applications

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the operation of dc machines.
- Analyze the differences in operation of different dc machine configurations.
- Analyze single phase and three phase transformers circuits

UNIT I: Magnetic fields, magnetic circuits and Magnetic Forces (10 Hours)

Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; B-H curve of magnetic materials, hysteresis and eddy current losses, Concept of statically and dynamically induced emf, Lorentz's Equation of Force
Energy stored in the magnetic circuits; Field energy and mechanical energy, determination of mechanical force; flow of energy in electromechanical devices.

UNIT II: DC machines (8 Hours)

Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

UNIT III: DC machine - motoring and generation (8 Hours)

Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt, series and compound. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed, Characteristics of generators and motors: separately excited, shunt ,series and compound. Speed control of DC motors, Losses, load testing and back-to-back testing of DC machines, Starting of DC motor

UNIT IV: Transformers-1 (8 Hours)

Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current

UNIT V: Transformers-2 (8 Hours)

Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.

Text books:

1. P. S. Bimbhra, " Electrical Machinery", Khanna Publishers, 2011.
2. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Reference Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.
3. M. G. Say, " Performance and design of AC machines", CBS Publishers, 2002.

EE2102 **ANALOG ELECTRONIC CIRCUITS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **4-1-0-5**

Course Outcomes:

- To introduce the semiconductor devices like Diode, BJT, MOSFET and their applications
- To know the linear and non-linear applications of operational amplifiers.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the characteristics of transistors.
- Design and analyse various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Understand the functioning of OP-AMP and design OP-AMP based circuits.

UNIT I: Diode circuits (10 Hours)

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

UNIT II: BJT circuits (10 Hours)

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common-collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits

UNIT III: MOSFET circuits (12 Hours)

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans-conductance, high frequency equivalent circuit.

UNIT IV: Operational amplifiers (8 Hours)

Ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

UNIT V: Applications of op-amp (14 Hours)

Linear applications of op-amp: Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift).Analog to Digital Conversion.

Nonlinear applications of op-amp: Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators. Precision rectifier, peak detector. Monoshot, 555 timer.

Text Books:

1. A. S. Sedra and K. C. Smith, " Microelectronic Circuits", New York, Oxford University Press, 1998.
2. J. V. Wait, L. P. Huelsman and G. A. Korn, "Introduction to Operational Amplifier theory and applications", McGraw Hill U. S., 1992.
3. J. Millman and A. Grabel, " Microelectronics", McGraw Hill Education, 1988.

Reference Books

1. P. Horowitz and W. Hill, "The Art of Electronics", Cambridge University Press, 1989.
2. P. R. Gray, R. G. Meyer and S. Lewis, " Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, 2001.

EE2103 **ELECTROMAGNETIC FIELDS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-1-0-4**

Course Objectives: To provide the basic knowledge

- To find electric and magnetic fields for symmetrical charge and current configurations.
- To deduce EM wave propagation in free space and in dielectric medium
- To analyze electromagnetic wave propagation in guiding structures under various matching conditions
- To understand the power flow mechanism in the losssy and lossless transmission lines.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- To understand the basic laws of electromagnetism.
- To obtain the electric and magnetic fields for simple configurations under static conditions.
- To analyse time varying electric and magnetic fields.
- To understand Maxwell's equation in different forms and different media.
- To understand the propagation of EM waves.

UNIT I: Review of Vector Calculus (6 hours)

Vector algebra addition, subtraction, components of vectors, scalar and vector multiplications triple products, three orthogonal coordinate systems (rectangular, cylindrical and spherical). Vector calculus differentiation, partial differentiation, integration, vector operator del, Gradient, divergence, and curl; integral theorems of vectors. Conversions of a vector from one coordinate system to another.

UNIT II: Electrostatics (8 Hrs)

Coulomb's Law, Electric Field Intensity due to different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential due to different Charge Distributions, Relations Between E and V, Equipotential Surfaces, Energy Density in the Electrostatic Field.

UNIT III: Conductor, Dielectric and Boundary conditions (8 Hrs)

Convection and Conduction Currents, current density, continuity Equation, conductor, Dielectric materials and their properties. Boundary conditions between conductor-dielectrics, dielectric-dielectric and conductor-free space. Poisson's and Laplace's equations, General procedure for solving Poisson's and Laplace's equation.

UNIT IV: Magneto statics (10 Hrs)

Biot-Savart's Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Magnetisation in material,Magnetic torque and moments, Inductances and Magnetic Energy,
Maxwell's Equations (Time Varying Fields): Faraday's Law, General Field Relation for Time Varying Electric And Magnetic Field, Maxwell's Equations in Different Forms, Conditions at a Boundary Surface : Dielectric-Dielectric and Dielectric-Conductor Interfaces. Poynting Vector and Poynting Theorem.

UNIT V: Electromagnetic waves (10 Hrs)

Wave Equations for Conducting Media, Uniform Plane Waves – Definition, Relations Between E & H, plane wave in good conductor, skin effect, skin depth.
Transmission Lines: Types, Parameters, Transmission Line Equations, Expressions for Characteristic Impedance, Input Impedance Relations, SC and OC Lines, Reflection Coefficient, UHF Lines as Circuit Elements : $\lambda/4$, $\lambda/2$, $\lambda/8$ Lines – Impedance Transformations, Single Stub Matching.

Text Books:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. A. Pramanik, "Electromagnetism - Theory and applications", PHI Learning Pvt. Ltd, New Delhi, 2009.
3. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.

Reference Books:

1. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
2. W. J. Duffin, " Electricity and Magnetism" , McGraw Hill Publication, 1980.
3. W. J. Duffin, " Advanced Electricity and Magnetism" , McGraw Hill, 1968.

EE2701 **ANALOG ELECTRONIC CIRCUITS LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objective:

- To provide practical Exposure for the students of semiconductor devices, operation
  amplifiers and their application

Course Outcome: At the end of this course, students will be able to

- Understand the characteristics of transistors.
- Design and analyse various rectifier and amplifier circuits.
- Design sinusoidal and non-sinusoidal oscillators.
- Design OP-AMP based circuits.

LIST OF EXPERIMENTS:

1. Verification of Network Theorems
2. Familiarization with electronic components and usage of multimeter (measurement of resistance, classification of capacitors, diode testing)
3. Familiarization with Oscilloscope, signal generator and further usage of multimeters
4. Frequency response and square wave resting of R-C, C-R and R-L networks
5. Half-wave and full-wave rectifiers, rectification with capacitive filters, zener diode and IC regulation
6. Studies on CE amplifiers
7. Studies on Analog Circuits using OP-AMP
8. Studies on logic gates
9. Studies on 555 circuits, J-K flip-flop, counters and shift registers

ME2104 **ENGINEERING MECHANICS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-1-0-4**

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the concepts of co-ordinate systems.
- Analyse the three-dimensional motion.
- Understand the concepts of rigid bodies.
- Analyse the free-body diagrams of different arrangements.
- Analyse torsional motion and bending moment.

UNIT I: Introduction to vectors and tensors and co-ordinate systems

Vector and tensor algebra; Indical notation; Symmetric and anti-symmetric tensors; Eigenvalues and Principal axes. Three-dimensional Rotation: Three-dimensional rotation: Euler's theorem, Axis-angle formulation and Euler angles; Coordinate transformation of vectors and tensors.

UNIT II: Kinematics of Rigid Body

Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two- and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.

UNIT III: Kinetics of Rigid Bodies

Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.

UNIT IV: Free Body Diagram

Examples on modelling of typical supports and joints and discussion on the kinematic and kinetic constraints that they impose. General Motion: Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin. Friction: Concept of Friction; Laws of Coulomb friction; Angle of Repose; Coefficient of friction.

UNIT V: Bending Moment

Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams. Torsional Motion: Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.

Text Books:

1. F. P. Beer and E. R. Johnson (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
2. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.

Reference Books

1. J. L. Meriam and L. G. Kraige (2013) Engineering Mechanics: Statics and Dynamics by Wiley Publication
2. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
3. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
4. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
5. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
6. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
7. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

IV SEMESTER

S.No.	Course Code	Course Title	Course Category	Hours per week L	T	P	Total Contact Hours	Credits
1	EE2201	Electrical Machines-II	PCC	3	0	0	3	3
2	EE2202	Power Electronics	PCC	3	0	0	3	3
3	EE2203	Digital Electronics	PCC	3	0	0	3	3
4	EE2204	Power Systems-I	PCC	3	0	0	3	3
5	EE2205	Signals and Systems	PCC	2	1	0	3	3
6	EE2801	Electrical Machines-I Lab	PCC	0	0	3	3	1.5
7	EE2802	Power Electronics Lab	PCC	0	0	3	3	1.5
8	EE2803	Digital Electronics Lab	PCC	0	0	2	2	1
9	HS2201	Delvlopement of Socities and Communication Skills-I	HSS	3	0	0	3	3
Total				17	1	8	26	22

EE2201 **ELECTRICAL MACHINES-II**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives: This course introduces the concept of

- The concepts of rotating magnetic fields.
- Construction and principle of operation of ac machines (Induction and Synchronous Machines)

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the concepts of rotating magnetic fields.
- Understand the operation of ac machines
- Analyze performance characteristics of ac machines.

UNIT I : Fundamentals of AC machine windings (6 Hours)

Physical arrangement of windings in stator and cylindrical rotor; slots for windings; concentrated winding, distributed winding, single- layer winding, full-pitch coils, pitch factor, distribution factor, elimination of harmonics, Air-gap MMF distribution with fixed current through winding - concentrated and distributed.

UNITII: Pulsating and revolving magnetic fields (6 Hours)

Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement, Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings, Windings spatially shifted by 90 degrees, Addition of pulsating magnetic fields, Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

UNIT III: Three Phase Induction Machines (12 Hours)

Construction, Types (squirrel cage and slip-ring). Equivalent circuit. Phasor Diagram, Torque Slip Characteristics, Starting and Maximum Torque, Losses and Efficiency. Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors, Concept of Cogging and Crawling, Double cage rotor induction motor , Testing of induction motor: Circle diagrams. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

UNITIV: Single-phase induction motors (6 Hours)

Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications

UNIT V: Synchronous machines (12 Hours)

Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory,analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, " Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bimbhra, " Electrical Machinery", Khanna Publishers, 2011.
4. I. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

Reference Books:

1. A. S. Langsdorf, " Alternating current machines", McGraw Hill Education, 1984.
2. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007

EE2202 **POWER ELECTRONICS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives: This course will develop students' knowledge in/on

- Characteristics and applications of basic power semiconductor switches
- Controlled rectifier circuits, DC-DC converter, inverter, AC voltage controller and cycloconverters

Course Outcomes: At the end of this course students will demonstrate the ability to

- Understand the differences between signal level and power level devices.
- Analyze controlled rectifier circuits.
- Analyze the operation of DC-DC choppers.
- Analyze the operation of voltage source inverters

UNIT I: Power switching devices (8 Hours)

Diode, Thyristor, BJT,MOSFET, IGBT: I-V Characteristics and switching characteristics; Firing circuit for thyristor; Voltage and current commutation of a thyristor; Gate drive circuits for MOSFET and IGBT, Daic and Traic.

UNIT II: Thyristor rectifiers (12 Hours)

Single-phase half-wave and full-wave rectifiers, Single-phase full-bridge thyristor rectifier with R, RL and RLE loads; Three-phase full-bridge thyristor rectifier with R, RL loads; Input current wave shape and power factor, effect of source impedance and dual converter.

UNIT III: DC-DC converter (8 Hours)

Elementary chopper with an active switch and diode, concepts of duty ratio and average voltage, power circuit of a buck converter, boost converter and buck-boost converter analysis and waveforms at steady state, relation between duty ratio and average output voltage, Voltage ripple and current ripple, introduction to isolated DC-DC converters.

UNIT IV: Inverters (10Hours)

Single-phase voltage source inverter, three-phase voltage source inverter (180 & 120 degree conduction modes), modulation techniques (PWM, SPWM), current source inverter

UNIT V: AC voltage controller and cycloconverters (5 hours)

Principle of phase control, principle of integral cycle control, single phase voltage controllers; principle of cyclo-converter operation, single phase to single phase cyclo-converter and single phase to three phase cyclo-converter.
Applications: Battery Charger, UPS and SMPS

Text Books:

1. M. H. Rashid, "Power Electronic Devices, Circuits and Applications" Pearson Education India, 2009.
2. N. Mohan and T. M. Undeland, "Power Electronics: Converters, applications and Design", John Wiley & Sons, 2007.

Reference Books:

1. R. W. Erickson and D. Maksimovic, " Fundamentals of Power electronics", Springer Science & Business Media, 2007.
2. L. Umanand, " Power Electronics: Essentials and Applications", Wileey India, 2009.

EE2203 **DIGITAL ELECTRONICS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives: This course introduces

- Concept of logic families and logic gates
- The concepts of various combinational and sequential circuits.
- Analog to Digital conversion and Digital to Analog conversion.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand working of logic families and logic gates.
- Design and implement Combinational and Sequential logic circuits.
- Understand the process of Analog to Digital conversion and Digital to Analog conversion.

UNIT I: Fundamentals of Digital Systems and logic families (10 Hours)

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic

UNIT II : Combinational Digital Circuits (10 Hours)

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, digital comparator, parity checker/generator, code converters, priority encoders, decoders

UNIT III: Sequential circuits and systems (10 Hours)

1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K, T and D types flip-flops, applications of flip-flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops , asynchronous sequential counters, applications of counters.

UNIT IV : A/D and D/A Converters (7Hours)

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs

UNIT V: Semiconductor memories and Programmable logic devices. (5 Hours)

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory(RAM)

Text Books:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.

Reference Books:

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.

EE2204 **POWER SYSTEMS-I**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives: This course introduce

- The concepts generation and distribution of electrical power
- Economics aspects of power systems
- Overhead Line Insulators and underground cables

Course Outcomes: After completion of this course, students will be able to

- Describe the operation of conventional generating stations
- Describe about the different types of substations available
- Determine Different Types of Tariff's in power system
- Design Distribution of voltage along the string insulators & Solve Problems
- Discuss underground cables & Solve Problems

UNIT- I: Conventional and Non-conventional Energy Sources (8 Hours)

Introduction: Typical Layout of an Electrical Power System–Present Power Scenario in India.
Generation of Electric Power: Conventional Sources (Qualitative): Hydro station, Steam Power Plant, Nuclear Power Plant and Gas Turbine Plant.
Non Conventional Sources (Qualitative): Ocean Energy, Tidal Energy, Wave Energy, wind Energy, Fuel Cells, and Solar Energy, Cogeneration and energy conservation and storage.

UNIT-II: Substations (6 Hours)

Air insulated substations - Indoor & Outdoor substations: Substations layout showing the location of all the substation equipment. Bus bar arrangements in the Sub-Stations: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.
Gas insulated substations (GIS) – Advantages of Gas insulated substations, different types of gas insulated substations, single line diagram of gas insulated substations, bus bar, construction aspects of GIS, Installation and maintenance of GIS, Comparison of Air insulated substations and Gas insulated substations.

UNIT- III: Overhead Line Insulators and Insulated Cables (10 Hours)

Overhead Line Insulators: Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators.
Insulated Cables: Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables.

UNIT- IV: Corona and Sag (10 Hours)

Corona: Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Disadvantages of corona, interference between power and Communication lines.

Mechanical design of transmission lines: The Catenary curve, Sag Tension calculations, Stringing chart, Sag template, Equivalent span, Stringing of conductors, Vibration and Vibration dampers

UNIT- V: Economics of Generation and Distribution (8 Hours)

Economics of Generation: Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load duration curve, number and size of generator units. Base load and peak load plants. Cost of electrical energy-fixed cost, running cost, Tariff on charge to customer.

A.C. Distribution: Introduction, AC distribution, Single phase, 3-phase, 3 phase 4 wire system, bus bar arrangement, Selection of site for substation.

D.C. Distribution: Calculations, uniformly loaded distributor fed at one end, distributor fed at both ends, distributor with both concentrated and uniform loading, rind and with inter connect

Text books:

1. W.D.Stevenson –"Elements of Power System Analysis", Fourth Edition, McGraw Hill, 1984.
2. C.L. Wadhwa –"Generation, Distribution and Utilization of Electrical Energy", Second Edition, New Age International, 2009
3. C.L. Wadhwa –"Electrical Power Systems", Fifth Edition, New Age International, 2009

Reference Books:

1. M.V. Deshpande –"Elements of Electrical Power Station Design", Third Edition, Wheeler Pub. 1998
2. H.Cotton & H. Barber-"The Transmission and Distribution of Electrical Energy", Third Edition, ELBS, B.I.Pub., 1985
3. Syed A Nasar, "Electric Power Systems" ,Mcgraw-Hill, 1/e, 2006.

EE2205 **SIGNALS AND SYSTEMS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **2-1-0-3**

Course Objectives: This course introduces

- Concepts of signals and systems and their characteristics
- Various mathematical tools like Fourier, Laplace and z- transforms to analyze an LTI systems

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the concepts of continuous time and discrete time systems.
- Analyse systems in complex frequency domain.
- Understand sampling theorem and its implications.

UNIT I: Introduction to Signals and Systems (6 hours):

Signals and systems as seen in everyday life, and in various branches of engineering and science. continuous and discrete time signals, continuous and discrete amplitude signals, properties of signal, Power and energy of a signal, some special signals of importance: unit step, unit impulse, ramp, parabolic sinusoid, complex exponential,. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

UNIT II: Behavior of continuous and discrete-time LTI systems (8 hours)

Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

UNIT III: Fourier Transforms(8 hours)

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Properties of Fourier series, Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Properties of Fourier Transforms, Fourier domain duality. The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.

UNIT IV: Laplace and z-Transforms (10 Hrs)

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

UNIT V: Sampling and Reconstruction (6 hours)

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

Text Books:

1. A. V. Oppenheim, A. S. Willsky and S. H. Nawab, “ Signals and systems”, Prentice Hall India, 1997.
2. B. P. Lathi, “ Linear Systems and Signals” , Oxford University Press, 2009.
3. M. J. Robert “ Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.

Reference Books:

1. J. G. Proakis and D. G. Manolakis, “ Digital Signal Processing: Principles, Algorithms, and Applications”, Pearson, 2006.
2. H. P. Hsu, “ Signals and systems” , Schaum’s series, McGraw Hill Education, 2010.
3. S. Haykin and B. V. Veen, “ Signals and Systems” , John Wiley and Sons, 2007.
4. A. V. Oppenheim and R. W. Schafer, “ Discrete-Time Signal Processing” , Prentice Hall, 2009.

EE2801 **ELECTRICAL MACHINES-I LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-3-1.5**

Course Objective:

- To expose the students to the operation of DC machines, transformers and give them experimental skills.

Course Outcomes: Upon completion of the course the student will be able to

- Analyze the characteristics of DC machines and transformers
- Perform tests on DC Machines and transformer and evaluate their performance

Any ten of the following experiments

1. To obtain magnetization characteristics of a d.c. shunt generator.
2. Polarity and ratio test of single phase transformers.
3. To obtain load characteristics of a d.c. shunt generator and compound generator
4. To obtain efficiency of a dc shunt machine using Swinburn's test.
5. To perform Hopkinson's test and determine losses and efficiency of DC machine.
6. To obtain speed-torque characteristics of a dc shunt motor.
7. To obtain speed control of dc shunt motor using
   (a) armature resistance control (b) field control
8. To obtain equivalent circuit, efficiency and voltage regulation of a single phase transformer using O.C. and S.C. tests.
9. To obtain efficiency and voltage regulation of a single phase transformer by Sumpner's test.
10. Load test on dc series generator
11. Field's test

EE2802 **POWER ELECTRONICS LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-3-1.5**

Course Objectives: To provide practical exposure on

- Characteristics of basic power semiconductor switches
- Applications of basic power semiconductor switches like controlled rectifier circuits, DC-DC converter, inverter, AC voltage controller etc.

Course Outcomes: After completion of this laboratory course, students will be able to

- Determine the power semiconductor switches characteristics and their applications.
- Design gate firing & commutation circuits for SCRs.
- Analyze the operation of converters, inverters and choppers.
- Design and simulate power electronic circuits and plot their characteristics.

Any eight experiments should be conducted

1. (a) Study of Characteristics of SCR, MOSFET & IGBT
   (b) Gate firing circuits for SCR's
2. (a) Single Phase Semi-converter with R and RL load
   (b) Single Phase fully controlled bridge converter with R and RL loads
   (c) Single Phase dual converter with RL loads
3. (a) Three Phase Semi-converter with R-load
   (b)Three Phase Bridge converter with R and RL loads
4. Isolated DC-DC converter
5. Single phase half bridge and full bridge inverter
6. Single Phase series inverter with R and RL loads
7. Single Phase Parallel inverter with R and RL loads
8. Single Phase AC Voltage Controller with R and RL Loads
9. Single Phase Cycloconverter with R and RL loads

Reference books:

1. M.H.Rashid, Simulation of Electric and Electronic circuits using PSPICE – by M/s PHI Publications.

EE2803 **DIGITAL ELECTRONICS LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objectives: To provide practical exposure on

- Various combinational and sequential circuits and filters.
- Applications of Operational Amplifier as adder, integrator and voltage to current converters.

Course Outcomes: Upon completion of this course the student will be able to

- Design counters, NAND gate and adders.
- Design multiplexer, 7-segment LED display and LPF, HPF, BPF
- Analyze the application of Operational Amplifier as adder, integrator and voltage to current converters.

LIST OF EXPERIMENTS: Any TEN of the following experiments

1. Design of a counter asynchronous and synchronous
2. I/O characteristics of a NAND gate
3. Design of a full adder circuit
4. Design of a digital comparator
5. Simplification Boolean function using K-map
6. Design of a multiplexer
7. Design of a 7-segment LED display
8. To study application of Operational Amplifier as adder, integrator and voltage to current converters.
9. Design of filters
    a. To design a low pass filter Second order filters using operational amplifier for cutoff frequency 1 KHz.
    b. To design a high pass filter Second order filters using operational amplifier for frequency 12 KHz.
    c. To design a band pass filter with unit gain of pass band from 1 KHz to 12 KHz.
10. To study application of Operational Amplifier as voltage comparator.
11. To generate triangular & square wave using operational amplifier.
12. To study regulation of unregulated power supply using IC 7805/7812 voltage regulator and measure the load and line regulations

V SEMESTER

S.No.	Course Code	Course Title	Course Category	Hours per week L	T	P	Total Contact Hours	Credits
1	EE3101	Power Systems-II	PCC	3	0	0	3	3
2	EE3102	Control Systems	PCC	3	1	0	4	4
3	EE3103	Electrical Measurements and Instrumentation	PCC	3	0	0	3	3
4	EE3104	Micro Processors	PCC	3	0	0	3	3
5	EE3701	Electrical Machines-II Lab	PCC	0	0	3	3	1.5
6	EE3702	Electrical Measurements and Instrumentation Lab	PCC	0	0	2	2	1
7	EE3703	Micro Processors Lab	PCC	0	0	2	2	1
8		Open Elective-I (Oops)	OEC	3	0	0	3	3
9		Seminar-I (Technical)	Seminar	0	0	2	2	1
Total				15	1	9	25	20.5

EE3101 **POWER SYSTEMS-II**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objective: To provide the knowledge to

- Analyze transmission line performance
- Apply load compensation techniques to control reactive power
- Understand the application of per unit quantities
- Determine the fault currents for symmetrical and unbalanced faults

Course Outcomes: After completion of this course, students will be able to

- Analyze circuit parameters of transmission lines & transmission line performance & Solve Problems.
- Describe the voltage control methods and different compensation methods available
- Explain the significance of per unit quantities.
- Determine the fault currents for symmetrical and unbalanced faults

UNIT I: Transmission Line Parameters (10 Hours)

Inductance and Capacitance Calculations of Transmission Lines: Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical and unsymmetrical spacing, Composite conductors-transposition, bundled conductors, and effect of earth on capacitance, Skin and Proximity effect

UNIT II: Performance of Transmission Lines (8 Hours)

Representation of lines, short transmission lines, medium length lines, nominal T and PI-representations, long transmission lines. The equivalent circuit representation of a long Line, A, B, C, D constants, Ferranti Effect, Power flow through a transmission line, receiving end power circle diagram.

UNIT III: Voltage Control and Compensation In Power Systems (8 Hours)

Voltage Control : Introduction – methods of voltage control, shunt and series capacitors / Inductors, tap changing transformers, synchronous phase modifiers.
Introduction to compensation in power systems: Load ability characteristics of overhead lines – Uncompensated transmission line – Symmetrical line – Radial line with asynchronous load – Compensation of lines.

UNIT IV: Travelling Waves on Transmission Lines and Per Unit Representation (10

Hours)

Travelling Waves on Transmission Lines: Production of traveling waves, open circuited line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at T-junction line terminated through a capacitance, capacitor connection at a T-junction, Attenuation of travelling waves.

Per Unit Representation of Power Systems : The one line diagram, impedance and reactance diagrams, per unit quantities, changing the base of per unit quantities, advantages of per unit system.

UNIT V: Symmetrical Components and Fault Analysis (8 Hours)

Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks, fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three phase fault, faults on power systems, faults with fault impedance, reactors and their location, short circuit capacity of a bus.

Text Books:

1. John J. Grainger & W.D. Stevenson: Power System Analysis – Mc Graw Hill International 1994.
2. C.L. Wadhwa: Electrical Power Systems – New Age International Pub. Co.Third Edition, 2001.
3. D.P. Kothari and I.J. Nagrath, Modern Power System Analysis - Tata Mc Graw Hill Pub. Co., New Delhi, Fourth edition, 2011

Reference Books:

1. Hadi Scadat: Power System Analysis – Tata Mc Graw Hill Pub. Co. 2002
2. W.D. Stevenson : Elements of Power system Analysis – McGraw Hill International Student Edition.
3. Miller “Reactive power control in Electric systems “Wiley , 2/e ,2011

EE3102 **CONTROL SYSTEMS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-1-0-4**

Course Objectives:

- To introduce the principles and applications of control systems in everyday life.
- The emphasis of this course is laid on stability analysis and design aspects of control systems using classical control theory approaches

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Understand the modellingof linear-time-invariant systems using transfer function and state-space representations.
- Understand the concept of stability and its assessment for linear-time invariant systems.
- Design simple feedback controllers.

UNIT I: Introduction to control problem (10 hours)

Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra, Signal Flow Graph.

UNIT II: Time Response Analysis (10 hours)

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique construction of Root-loci.

UNIT III: Frequency-response analysis (10 hours)

Design specifications in frequency-domain, Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

UNIT IV: Introduction to Controller Design (10 hours)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design.. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

UNIT V: State variable Analysis (10 hours)

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback.

Introduction to Optimal Control and Nonlinear Control: Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

Text Books:

1. M. Gopal, " Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, " Automatic Control System", Prentice Hall, 1995.

Reference Books:

1. K. Ogata, " Modern Control Engineering", Prentice Hall, 1991.
2. J. Nagrath and M. Gopal, " Control Systems Engineering", New Age International, 2009

EE3103 ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

- To understand the operating principle of various types of analog instruments for measuring voltage, current, power, phase, frequency and energy.
- To determine the circuit parameters using AC and DC bridges.
- To understand operating principles of electronic measuring instruments

Course Outcomes: Upon competition of the course students will be able to

- Compare performance of MC, MI and Dynamometer types of measuring instruments, Energy meters and CRO
- Compute the errors in CTs and PTs.
- Selection of transducers for the measurement of temperature, displacement and strain .

UNIT I : Measurement of Voltage and Current (8 Hours)

Introduction: Methods of measurement, Measurement system, Classification of instrument systems, Characteristics of instruments & measurement systems, Definition of accuracy, precision, resolution. Speed of response. Errors in measurement& its analysis. Loading effect due to shunt and series connected instruments.

Measurement of Voltage and Current: General features, Construction, principle of operation and torque equation of Permanent magnet moving coil(PMMC), Moving Iron(MI), electrodynamometer, Induction, Thermoelectric and rectifier type instruments. Extension of instrument ranges using shunt, multipliers.

UNIT II: Measurement of Electrical Power and Energy (10 Hours)

Measurement of power: Construction and principle of operation of Electrodynamometer type wattmeter. Errors in Electrodynamometer type wattmeter. Low power factor wattmeter. Measurement of power in single phase system.

Measurement of phase, frequency and energy: Single phase and three phase electro dynamometer power factor meter, moving iron power factor meter. Construction and operation of different types of frequency meters. Construction and principle of operation of Single phase induction type energy meters, errors in energy meter and their compensation methods. Testing of energy meter by phantom loading method.

Instrument Transformers: CT and PT; their errors, Applications of CT and PT in the extension of instrument range.

UNIT III: Measurement of Electrical Parameters (8 Hrs)

Measurement of resistance: Measurement of low resistance by kelvin's double bridge, measurement of medium resistance by wheatstone bridge, voltmeter and ammeter method,substitution method and ohmmeter method.measurement of high resistance by loss of charge method, direct deflection method and Meggar.

Measurement of inductance and capacitance: Measurement of inductance with the help of AC Bridges(Maxwell's Inductance, Anderson, Hay's and owen's bridges)Measurement of capacitance with the help of AC Bridges (De Sauty's, Schering Bridge) their Applications and Limitations. Q meter.

UNIT IV: Potentiometers, Sensors & Transducers (8 Hours)

Principle of operation and application of Crompton's DC potentiometer, Polar and co-ordinate type of AC potentiometers. Magnetic Measurement- Ballistic galvanometer, Flux meter, Determination of hysteresis loop, measurement of iron losses.

Introduction to sensors & transducers, RTD, Thermistors, LVDT, Strain Gauge, Piezoelectric Transducers, Hall effect sensors. Flow measurement using magnetic flow measurement.

UNIT V: Digital Measurement of Electrical Quantities (8 Hours)

Advantages of digital instruments. Concept of digital measurement. Block diagram and theory of digital voltmeter, digital Frequency meter, Spectrum analyzer and harmonic distortion analyzers. Block diagram and working of Cathode Ray Oscilloscope, Cathode Ray Tube (CRT) & its components, Applications of CRO in measurement, Lissajous Pattern, Dual trace & dual beam oscilloscopes

Text Books:

1. A. K. Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons, India
2. J. B. Gupta, "Electrical Measurement & Measuring Instrument", S. K. Kataria & Sons

Reference Books:

1. E. W. Golding & F. C. Widdis, "Electrical Measurement &Measuring Instrument", A. W. Wheeler & Co. Pvt. Ltd. India
2. Forest K. Harris, "Electrical Measurement", Willey Eastern Pvt. Ltd. India

EE3104 **MICRO PROCESSORS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objective:

- To familiarize with the architecture of 8085 processor, assembling language programming and interfacing with various modules.
- To understand 8051 Microcontroller concepts, architecture, programming and application of Microcontrollers.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Do assembly language programming.
- Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
- Develop systems using different microcontrollers.

UNIT I: Fundamentals of Microprocessors: (8 Hours)

Fundamentals of Microprocessor, Architecture 8-bit Microprocessor (8085) and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded systems. Overview of the 8051 family.

UNIT II: Instruction Set and Programming (8 Hours)

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8085 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools

UNIT III: Memory and I/O Interfacing (6 Hours):

Memory and I/O expression busses, control signals, memory wait states. Interfacing of peripheral devices such as General purpose I/O, ADC, DAC, timers, counters and memory devices.

UNIT IV: External Communication Interface (6 Hours)

Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee.

UNIT V : Introduction to Advanced micro controllers (10 Hours)

Arduino programming and applications

Text Books:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.
2. K. J. Ayala, “ 8051 Microcontroller”, Delmar Cengage Learning,2004.
   3. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996

Reference Books:

1. D. A. Patterson and J. H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.
2. R. Kamal, “Embedded System”, McGraw Hill Education,2009.

EE3701 **ELECTRICAL MACHINES-II LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-3-1.5**

Course Objectives:

- To provide practical exposure to ac machines (Induction and Synchronous machines)

Course Outcomes: Upon completion of the course the student will be able to

- Analyze the characteristics of synchronous machines and Induction motors
- Perform tests on synchronous machines and Induction motors and evaluate their performance

LIST OF EXPERIMENTS:

1. To perform no load and blocked rotor tests on a three phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three phase induction motor and draw Torque -speed characteristics.
3. To determine speed-torque characteristics of three phase slip ring induction motor and study the effect of including resistance in the rotor circuit.
4. To determine speed-torque characteristics of single phase induction motor and study the effect of voltage variation.
5. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.
6. Determine voltage regulation at full load and at unity, 0.8 lagging and leading power factors by
   (i) EMF method
   (ii) MMF method.
7. To study synchronization of an alternator with the infinite bus by using:
   (i) dark lamp method
   (ii) two bright and one dark lamp method.
8. To determine V-curves and inverted V-curves of a three phase synchronous motor.
9. To determine Xd and Xq of a three phase salient pole synchronous machine using the slip test and to draw the power-angle curve.
10. Scott connection

EE3702 **ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB**

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**0-0-2-1**

Course Objectives:

- To provide students with good depth of knowledge of electrical and electronic measuring instruments.
- To understand measurement errors and non ideal electrical devices.

Course Outcomes: At the end of the course the student will be able to:

- Calibrate single phase energy meters
- Measure Resistance, Inductance and capacitance using AC and DC bridges
- Measure frequency, voltage peaks, phase difference with an oscilloscope.
- Compare performance of MC, MI and Dynamometer types of measuring instruments, Energy meters and CRO

LIST OF EXPERIMENTS

1. Introduction to Lab
   a. Measurement of phase difference and frequency of a sinusoidal ac voltage using C.R.O.
   b. Usage of DSO for steady state periodic waveforms produced by a function generator.
   c. Selection of trigger source and trigger level, selection of time-scale and voltage scale.
   d. Bandwidth of measurement and sampling rate.
   e. Download of one-cycle data of a periodic waveform from a DSO and use values to compute the RMS values using a C program.
   f. Usage of DSO to capture transients like a step change in R-L-C circuit.
2. Calibration of voltmeter and ammeter.
3. Calibration of Single phase Energy Meter
4. Measurement of power and power factor of a single phase inductive load and to study effect of capacitance connected across the load on the power factor.
5. Measurement of Reactive power using one wattmeter method
6. Measurement of low resistance by Kelvin's double bridge.
7. Measurement of L using a bridge technique as well as LCR meter.
8. Measurement of C using a bridge technique as well as LCR meter.
9. Measurement of High resistance and Insulation resistance using Megger.
10. Measurement of voltage, current and resistance using dc potentiometer

EE3703 MICROPROCESSORS LAB

Externals: 60Marks L-T-P-C

Internals: 40Marks 0-0-2-1

Course Objective:

- To familiarize with arduino board and micro controller.
- To understand the interfacing with interfacing with various modules.

Course Outcome:

- The student will be able to interface Keyboard, stepper motor and DC motor.
- The student will be able to interface traffic light, ADC and DAC.
- The student will be able to understand 8051 Microcontroller concepts, architecture, programming and application of Microcontrollers

LIST OF EXPERIMENTS:

1. Interface simple seven segment LED display with arduino and controller.
2. To Display "DEPT OF EEE" on LCD in 8-bit as well as 4-bit mode
3. Interface Keyboard and LCD with controller.
4. Interface Stepper Motor by controlling its direction and make it spin faster or slower arduino and controller..
5. Interface DC motor and control its speed using PWM technique. arduino and controller.
6. Interface Elevator to arduino and controller..
7. Interface Traffic Light with arduino and controller..
8. Interfacing ADC to Microcontroller.
9. Interface DAC with Microcontroller and generate multiple waveforms.
10. Interface Temperature Sensor to ADC and measure it on LCD with arduino and controller.

VI SEMESTER

S.No.	Course Code	Course Title	Course Category	Hours per week L	T	P	Total Contact Hours	Credits
1	EE3201	Power Systems Protection	PCC	3	0	0	3	3
2	EE3202	Power Systems Operation and Control	PCC	3	0	0	3	3
3	EE3801	Power Systems Lab	PCC	0	0	3	3	1.5
4	EE3802	Control Systems Lab	PCC	0	0	2	2	1
5	EE3803	Electrical simulation lab	PCC	0	0	2	2	1
6		Program Elective-I	PEC	3	0	0	3	3
7		Program Elective-II	PEC	3	0	0	3	3
8		Open Elective-II	OEC	3	0	0	3	3
9	HS3202	Human Values and Soft skills	HSMC	2	0	2	4	3
10		Mini Project	PROJ	0	0	2	2	1
11		Comprehensive Viva	PCC	0	0	0	0	0
12		Summer Intership	PCC	0	0	0	0	0
Total				17	0	11	28	22.5

EE3201 **POWER SYSTEMS PROTECTION**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objective:

- To compare and contrast electromagnetic, static and microprocessor based relays
- To apply technology to protect power system components
- To select relay settings of over current and distance relays.
- To analyze quenching mechanisms used in air, oil and vacuum circuit breakers

Course Outcomes: After completion of this course, students will be able to

- Compare electromagnetic with static relays
- Evaluate the of performance of Various Relays
- Understand about the concept of over voltage protection and insulation coordination
- Analyze Fundamental principles of circuit breakers & fuses

UNIT I: Relays (8 Hours)
Electromagnetic Relays - Basic Requirements of Relays – Primary and Backup Protection – Construction, Details of – Attracted Armature, Balanced Beam, Inductor Type and Differential Relays – Universal Torque Equation – Characteristics of Over Current, Direction and Distance Relays. Static Relays –Introduction to static relays, Advantages and Disadvantages over electromagnetic relays

UNIT II: Protection of Generators and Transformers (10 Hours)

Protection of Generators against Stator Faults, Rotor Faults, and Abnormal Conditions. Restricted Earth Fault and Inter-Turn Fault Protection. Numerical Problems On percentage Winding Unprotected. Protection of Transformers: Percentage Differential Protection, Numerical Problem on Design of CT s Ratio, Buchholtz Relay Protection, Numerical Problems.

UNIT III: Protection of Transmission Lines (8 Hours)

Protection of Feeder (Radial & Ring Main) Using Over Current Relays. Protection of transmission Line– 3 Zone Protection Using Distance Relays. Carrier Current Protection. Protection of Bus Bars.

UNIT IV: Overvoltage Protection and Insulation Coordination (8 Hours)

Over voltage due to arcing ground and Peterson coil, lightning, horngaps, surge diverters, rod gaps, expulsion type lightning arrester, valve type lightning arrester, ground wires, ground rods, counter poise, surge absorbers, insulation coordination, volt-time curves.

UNIT V: Circuit Breakers (10 Hours)

Introduction, arcing in circuit breakers, arc interruption theories, re-striking and recovery voltage, resistance switching, current chopping, interruption of capacitive current, oil circuit breaker, air blast circuit breakers, Vacuum Circuit Breaker, SF6 circuit breaker, operating mechanism, selection of circuit breakers, high voltage d.c. breakers, ratings of circuit breakers, testing of circuit breakers. Fuses : Introduction, fuse characteristics, types of fuses, application of HRC fuses, discrimination

Text Books:

1. Badriram and D.N. Vishwakarma, Power System Protection and Switchgear, TMH 2001
2. U.A.Bakshi, M.V.Bakshi: Switchgear and Protection, Technical Publications, 2009.
3. Switchgear and Protection – by Sunil S Rao, Khanna Publishers, 1992.

Reference

1. L.P.Singh ―Protective relaying from Electromechanical to Microprocessors‖, New Age International
2. "Electrical Power", by S. L. Uppal, Khanna pulishers,1988.
   Ravindranath & Chander, "Switch Gear & Protection" New Age International , 2/e, 2014

EE3202 **POWER SYSTEMS OPERATION AND CONTROL**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objective: At the end of the course the student will be able to:

- To understand the computation of load flows in a power systems
- To study the various methods of reactive power control in power systems and economic load scheduling
- To study load frequency control and its analysis in an isolated power system
- To study stability, stability limits and the dynamics of synchronous machines

Course Outcomes: After completion of this course, students will be able to:

- Compute the bus variables and the power flows in the system using various iterative methods
- Determine the optimal economic load scheduling.
- Determine the static and dynamic frequency response of a power system for a single area and two area system
- Predict the stability of power systems and determine the transient stability limits

UNIT I: Load flow studies (8 hours)

Introduction, Bus classification, Nodal admittance matrix, Transmission Network Representations: Bus Admittance frame and Bus Impedance frame. Formation of Ybus: Direct and Singular Transformation Methods, Load flow equations, Iterative methods – Gauss, Gauss Seidel and Newton Raphson methods. Newton decoupled and fast decoupled. Merits and Demerits of these methods, system data for load flow study.

UNIT II : Economic Operation of Power Systems (6 hours)

Distribution of load between units within a plant, transmission loss as a function of plant generation, calculation of loss coefficients, distribution of load between plants. Unit commitment: Introduction, constraints in unit commitment problems.

UNIT III: Load Frequency control (11 hours)

Introduction, Load frequency problem, Megawatt frequency (or P-F) control channel, Megavar voltage (or Q – V) control channel. Dynamic interaction between P-F and Q-V loops, Mathematical model of speed governing system, turbine models division of power system into control areas, P-F control of single control area (the uncontrolled and controlled cases) P-F control of two area systems (the uncontrolled and controlled cases).

UNIT IV: Power System Stability (8 hours)

The stability problem, steady state stability limit, Expression using ABCD parameters, steady state stability of synchronous machine. transient stability, swing equation, equal area criterion of stability and its further applications, step by step solution swing equation, some factors affecting transient stability & Methods of improving stability . Concept of Dynamic stability – effect of excitation on generator power limits.

UNIT V: Reactive Power–Voltage Control (9 hours)

Basics of reactive power control. Excitation systems – modeling. Static and dynamic analysis - stability compensation - generation and absorption of reactive power. Relation between voltage, power and reactive power at a node - method of voltage control - tap-changing transformer. System level control using generator voltage magnitude setting, tap setting of OLTC transformer and MVAR injection of switched capacitors to maintain acceptable voltage profile and to minimize transmission loss.

Textbooks:

1. John Grainger & William Stevenson Jr., "Power Systems Analysis", McGraw Hill, 1/e,
2. D.P.Kothari and I.J.Nagrath, Modern Power System Analysis, 4th Edn, Tata McGraw Hill Education Private Limited 2011.
3. C.L.Wadhwa, Electrical Power Systems, 3rd Edn, New Age International Publishing Co., 2001.

Reference Books:

1. Olle I Elgerd " Electric Energy Systems Theory", Tata McGraw Hill ,2/e ,2011
2. Chakrabarthi, Abhijit halder, "Power system analysis: Operation and Control", Prentice hall of India, 3/e, 2010.

EE3801 **POWER SYSTEMS LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-3-1.5**

Course Objective:

- Performance of long transmission lines and reactive power control
- Characteristics of protective relays
- Short circuit analysis and sequence components of power system elements
- Study of different faults on Transmission lines

Course Outcomes: After completion of this lab, students will be able to

- Determine the performance characteristics of a long transmission line and reactive power control
- Determine the operating characteristics of protective relays
- Compute fault currents and determine the sequence components of power system elements

List of experiments

1. Determination of Sequence Impedances of a cylindrical rotor Synchronous Machine.
2. Determination of Positive, Negative and zero sequence reactance of 3 phase Transformers
3. Fault analysis of 3 phase Alternator, (LG, LL, LLG, LLLG faults).
4. Determination of Sub transient reactance's of a Salient Pole Synchronous Machine.
5. To obtain the operating characteristics of IDMT over current relay
6. Characteristics of Percentage biased of Static Differential Relay
7. Performance and Testing of Generator Protection System.
8. To obtain the performance characteristics of long transmission line
9. To determine the breakdown strength of oil.
10. Reactive power control of long Transmission line

Any two simulation experiments listed below should be conducted using two electrical related soft wares

1. Distribution System Reliability Analysis.
2. Power System Fault Analysis.
3. Transmission Line Fault Analysis.

EE3802 **CONTROL SYSTEMS LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-2-1**

Course Objectives: To provide the practical exposure

- To strengthen the knowledge of Feedback control
- To inculcate the controller design concepts
- To familiarize with control systems components like servomotor, synchros and Magnetic amplifier.
- To familiarize programmable logic controller

Course Outcomes: At end of this course student will be able to

- Demonstrate time response of second order system
- Understand characteristics of control system components like servomotor, synchros and Magnetic amplifier.
- Design and understand PID control for temperature control application
- Design controller and compensators using simulation tools

Any Eight of the following experiments are to be conducted:

1. Time response of Second order system
2. Characteristics of Synchros
3. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor.
4. Effect of feedback on DC servo motor
5. Transfer function of DC motor
6. Effect of P, PD, PI, PID Controller on a second order systems
7. Lag and lead compensation – Magnitude and phase plot
8. Temperature controller using PID
9. Characteristics of magnetic amplifiers
10. Characteristics of AC servo motor

Any two simulation experiments are to be conducted:-

1. Simulation of Op-Amp based Integrator and Differentiator circuits.
2. Linear system analysis (Time domain analysis, Error analysis) .
3. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system
4. State space model for classical transfer function – Verification.

REFERENCE BOOKS:

1. Simulation of Electrical and electronics Circuits using PSPICE – by M.H.Rashid, M/s PHI Publications.
2. PSPICE A/D user's manual – Microsim, USA.
3. PSPICE reference guide – Microsim, USA.
4. MATLAB and its Tool Books user's manual and – Mathworks, USA.

EE3803 ELECTRICAL SIMULATION LAB

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**0-0-3-1.5**

Course Objective:

- To impart hands on experience in verification of circuit laws and theorems, measurement of circuit parameters, study of circuit characteristics and the simulation of power electronics circuits using PSPICE.
- Gives practical exposure to the usage of different circuits with different condition.
- Acquire skills of using computer packages MATLAB coding and SIMULINK in power Electronics and power system studies.

Course Outcome: Upon the successful completion of this course, the student is expected to gain the following skills:

- Understand the fundamentals and programming Knowledge in PSPICE.
- Able to understand the Transient & Steady State Performance of a system.
- Able to generate plots and export this for use in reports and presentations.
- Able to give practical experience with simulating physical systems

List of Experiments:

Any TEN of the following Experiments

1. Stability analysis(Bode, Root locus, Nyquist) of linear time invariant system
2. Effect P, PD, PI, PID controllers on a second order system
3. Simulation of Half wave & Full wave bridge rectifier .
4. Simulation of single phase bridge inverter
5. Simulation of Boost Converter
6. Performance evaluation of medium and long transmission lines .

7. Symmetrical component analysis
8. Load frequency control of single area and two area power system
9. Performance of FC-TCR compensator
10. Permanent Magnet DC motor simulation
11. Newton Raphson method of load flow analysis.
12. Gauss seidal method of load flow analysis.
13. Fault analysis

Reading:

1. C.L. Wadhwa: Electrical Power Systems –Third Edition, New Age International Pub. Co., 2001.
2. Hadi Sadat: Power System Analysis –Tata Mc Graw Hill Pub. Co. 2002.
3. Control Systems Engineering-I.J. Nagrath & M.Gopal- New Age International Pub. Co
4. A.E. Clayton & C.I. Hancock Performance and Design of DC Machines**.**

VII SEMESTER

S.No.	Course Code	Course Title	Course Category	Hours per week L	T	P	Total Contact Hours	Credits
1	EE4101	Utilization of Electrical Energy	PCC	3	0	0	3	3
2	EE4701	Energy systems lab	PCC	0	0	2	2	1
3		Program Elective-III	PEC	3	0	0	3	3
4		Program Elective-IV	PEC	3	0	0	3	3
5		Open Elective-III	OEC	3	0	0	3	3
6	BM4001	Slot for HSS (MEFA)	HSMC	3	0	0	3	3
7		Project-I	PROJ	0	0	6	6	3
Total				15		8	23	19

EE4101 **UTILIZATION OF ELECTRICAL ENERGY**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objective:

This course will develop students' knowledge in/on

1. Various electric traction systems with their performance.
2. Selection of motor for different industrial drives.
3. Electric heating and welding techniques.
4. Designing and selection of lamps for proper illumination

Course Outcomes : After completion of this course, students will be able to

- Choose the motor for different types of Electric traction systems.
- Evaluate the selection of a motor for different types of loads.
- Use various heating and welding techniques for different applications.
- Select and design the lamps for proper illumination. & Solve Problems

UNIT – I: INDUSTRIAL UTILIZATION (8 hours)

Introduction, Factors governing selection of Electric Motors, Nature of electric supply, Types of drives, Nature of loads, Standard Ratings of Motors, Choice of ratings of Motors, Types of Motors used in industrial Drives, Motors for particular service, speed control.

UNIT – II : ELECTRIC HEATING and WELDING (8 Hours)

Advantages and methods of electric heating, resistance heating induction heating and dielectric heating. Electric welding, resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding.

UNIT III: Illumination Systems (10 Hours)

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting. Discharge lamps

UNIT –IV: ELECTRIC TRACTION (10 Hours)

System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking-plugging rheostat braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves. Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and coefficient of adhesion.

UNIT V: Residential Electrical Systems (8 Hours)

Types of residential wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations
Introduction to Electric Vechicles: Historical Journey of Hybrids and Electric Vehicle, Economic and Environmental Impact of Electric Hybrid Vehicle

Text Books:

1. E. Openshaw Taylor, Utilisation of Electric Energy – by University press.
2. C.L. Wadhwa, Generation, Distribution and Utilization of electrical Energy, New Age International (P) Limited, Publishers, 1997

Reference Books

1. N.V.Suryanarayana, Utilization of Electrical Power including Electric drives and Electric traction, New Age International (P) Limited, Publishers, 1996.
2. Partab, Art & Science of Utilization of electrical Energy –Dhanpat Rai & Sons.

EE4701 **ENERGY SYSTEMS LAB**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **0-0-3-1.5**

Course Objective:

- To introduce the basic renewable energy systems

Course Outcome:

- The student will be able to understand PV cell characteristics
- The student will be able understand to interface with power converters and MPPT concept

1. V-I characteristics of solar panel at various levels of isolation.
2. Study of wind turbine generator.
3. Performance Study of Solar Flat Plate Thermal Collector Operation with Variation in Mass Flow Rate and Level of Radiation
4. Characterization of Various PV Modules Using large area Sun Simulator
5. Study of micro-hydel pumped storage system
6. Fuel Cell Experiment
7. Study of 100 kW solar PV plant
8. Simulation of PV and DC-DC converter interface
9. Simulation of MPPT for PV cell or module
10. Simulation of PV cells in parallel and series

BM4001 Managerial Economics and Financial Analysis

Externals: 60Marks	**L-T-P-C***
Internals: 40Marks	**3-1-0-3**

Course Objectives:

- The course describes the Nature And Scope of Managerial Economics. It gives complete study on the demand and elasticity of demand and methods of demand forecasting.
- It provides a detailed structure on the pricing strategies and shows clear picture methods and sources of raising finance.
- It gives a clear cut information of preparing final accounts and capital Budgeting techniques.

Course Outcome:

After the successful completion of this course, the learner will be able to know:

* The dynamic game of demand and supply, and how the trinity of Economics i.e. Demand, Supply and Scarcity make the things move around the globe.
* Principles of Microeconomics applied to industries.
* Concept of forecasting and applying forecasting techniques to address the challenges and opportunities in the organization they work.
* Cost and Production analysis, Break-Even analysis, Opportunity Cost, how to optimize organizational resources and how to minimize cost and maximize production, revenue and profit
* Different pricing structure and discount mechanism suitable for business firms.
* Market structure and how to exploit market structure for optimizing the benefits of organization.
* Capital requirements and sources of capital.

UNIT I: Introduction to Managerial Economics:

Definition, Nature and Scope of Managerial Economics-Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting.

UNIT II: Theory of Production and Cost Analysis:

Production Function - Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs. Cobb-Douglas Production function, Laws of Returns, Internal and External Economies of Scale.

Cost Analysis: Cost concepts, Opportunity cost. Fixed vs. Variable costs, Explicit costs Vs. Implicit costs. Out of pocket costs vs. Imputed costs. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems)- Managerial Significance and limitations of BEA.

UNIT III: Markets & Pricing Policies:

Market structures: Types of competition, Features of Perfect competition, Monopoly and Monopolistic Competition. Price-Output Determination in case of Perfect Competition and Monopoly. Objectives and Policies of Pricing- Methods of Pricing: Cost Plus Pricing. Marginal Cost Pricing, Sealed Bid Pricing, Going Rate Pricing, Limit Pricing, Market Skimming Pricing, Penetration Pricing.

UNIT IV: Introduction to Financial Accounting: Introduction to Financial Accounting: Double entry Book Keeping, Journal, Ledger, Trail Balance and Final Accounts (Trading account, Profit and Loss Account and Balance sheet with simple adjustments).

UNIT V: Capital and Capital Budgeting:

Capital and Capital Budgeting: Capital and its significance. Types of Capital. Estimation of Fixed and Working capital requirements. Methods and sources of raising finance. Nature and scope of capital budgeting, features of capital budgeting proposals. Methods of Capital Budgeting: Payback Method. Accounting Rate of Return (ARR) and Net Present Value Method, Internal Rate of Return (IRR).

Reference Books:

1. Aryasri: Managerial Economics and Financial Analysis, TMH,2009.
2. Varshney & Maheswari : Managerial Economics, Sulthan Chand,2009.
3. Raghunatha Reddy & Narasimhachary: Managerial Economics& Financial Analysis, Scitech. 2009.
4. V.Rajasekarn & R.Lalitha. Financial Accounting, Pearson Education. New Delhi. 2010
5. Suma Damodaran, Managerial Economics, Oxford University Press. 2009.

VIII SEMESTER

S.No.	Course Code	Course Title	Course Category	Hours per week L	T	P	Total Contact Hours	Credits
1		Program Elective-V	PEC	3	0	0	3	3
2		Open Elective-IV	OEC	3	0	0	3	3
3		Project-II	PROJ	0	0	16	16	8
4		Comprehensive Viva	PCC	0	0	0	0	0
		Total		6	0	16	22	14

LIST OF ELECTIVES

EEPE11 SPECIAL MACHINES

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objective:

- To understand the working principle and construction of stepper motors and switched reluctance motors.
- Demonstrate the ability to understand the construction of ,Amplidyne ,Metadyne and Regulex- third brush generator
- To gain knowledge in principle of operation and characteristics of permanent magnet

Course Outcome: At the end of the course the student will be able to:

- Identify the different features of special machines.
- Perform and analyze different methods to find Torque Pulsations for 180 degrees pole arc and 120 degree current sheet Brushless dc motors
- Elucidate the working and characteristics of stepper motors, VRSM motor and PMMM motor.

UNIT I : Special Types Of D.C Machines (8 Hours)

Series booster-Shunt booster-Non-reversible boost-Reversible booster
Armature excited machines—Rosenberg generator- The Amplidyne and metadyne— Rototrol and Regulex-third brush generator-three-wire generator-dynamometer.

UNIT II: Stepper Motors (9 Hours)

Introduction-synchronous inductor (or hybrid stepper motor), Hybrid stepping motor, construction, principles of operation, energisation with two phase at a time- essential conditions for the satisfactory operation of a 2-phase hybrid step motor- very slow- speed synchronous motor for servo control-different configurations for switching the phase windings-control circuits for stepping motors-an open-loop controller for a 2-phase stepping motor.

UNIT III: VR Stepping Motors and Switched Reluctance Motor(10 Hours)

Variable reluctance (VR) Stepper motors, single-stack VR step motors, Multiple stack VR motors-Open-loop control of 3-phase VR step motor-closed-Loop control of step motor, discriminator (or rotor position sensor) transilator, major loop-characteristics of step motor in open-loop drive – comparison between open-loop position control with step motor and a position control servo using a conventional (dc or ac) servo motor- Suitability and areas of application of stepper motors-5- phase hybrid stepping motor-single phase-stepper motor, the construction, operating principle torque developed in the motor.

Switched Reluctance Motor:

Introduction – improvements in the design of conventional reluctance motors- Some distinctive differences between SR and conventional reluctance motors-principle of operation of SRM-Some design aspects of stator and rotor pole arcs, design of stator and rotor and pole arcs in SR motor- determination of L(θ)--- θ profile –power converter for SR motor-A numerical example – Rotor sensing mechanism and logic control, drive and power circuits, position sensing of rotor with Hall problems—derivation of torque expression, general linear case.

UNIT IV: Permanent Magnet Motors and Brushless Dc Motor(10 Hours)

Permanent Magnet Motors: Introduction, Hysteresis loops and recoil line- stator frames (pole and yoke - part) of conventional PM dc Motors, Equivalent circuit of a PM-Development of Electronically commutated dc motor from conventional dc motor.

Brushless Dc Motor: Types of construction – principle of operation of BLDM- sensing and switching logic scheme, sensing logic controller, lockout pulses –drive and power circuits, Base drive circuits, power converter circuit-Theoretical analysis and performance prediction, modeling and magnet circuit d-q analysis of BLDM -transient analysis formulation in terms of flux linkages as state variables-Approximate solution for current and torque under steady state –

Theory of BLDM as variable speed synchronous motor (assuming sinusoidal flux distribution)- Methods or reducing Torque Pulsations, 180 degrees pole arc and 120 degree current sheet.

UNIT V: Linear Induction Motor (5 Hours)

Development of a double sided LIM from rotary type IM- A schematic of LIM drive for electric traction development of one sided LIM with back iron-field analysis of a DSLIM fundamental assumptions.

TEXT BOOKS

1. K.Venkataratnam, Special electrical machines, university press.
2. R.K. Rajput - Electrical machines - 5th edition.
3. V.V. Athani - Stepper motor: Fundamentals, Applications and Design, New age International publishers.

EEPE12 WIND AND SOLAR ENERGY SYSTEMS

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**3-0-0-3**

Course Objectives:

- To understand the basic aspects of renewable energy supply presenting fundamental characteristics of resource base (solar radiation, wind energy..etc).
- To understand the issues related to energy supply systems.

Course Outcomes: At the end of the course the student will be able to:

- Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
- Understand the basic physics of wind and solar power generation. Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy system

UNIT I: Physics of Wind Power: (5 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

UNIT II: Wind generator topologies: (12 Hours)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent- Magnet Synchronous Generators, Power electronics converters. Generator-Converter configurations, Converter Control.

UNIT III: The Solar Resource: (11 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Solar photovoltaic:

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV Unit, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

UNIT IV: Network Integration Issues: (8 Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

UNIT V: Solar thermal power generation: (4 Hours)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis

Text / References:

1. T. Ackermann, “ Wind Power in Power Systems” , John Wiley and Sons Ltd., 2005.

2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.

3. S. P. Sukhatme, “ Solar Energy: Principles of Thermal Collection and Storage”, McGraw

Hill, 1984.
4. H. Siegfried and R. Waddington, “ Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006.
5. G. N. Tiwari and M. K. Ghosal, “ Renewable Energy Applications”, Narosa Publications, 2004.
6. J. A. Duffie and W. A. Beckman, “ Solar Engineering of Thermal Processes” , John Wiley & Sons, 1991.

EEPE13 **POWER SEMICONDUCTOR DRIVES**

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**3-0-0-3**

Course Objectives: This course will develop students’ knowledge in/on

- The fundamentals and dynamics of electric drives
- The various types of the rectifier control and chopper control DC drives
- The AC voltage control, frequency control and slip power recovery control of Induction motor drives.
- Various types of synchronous motor drives and its speed torque characteristics

Course Outcomes: At the end of the course the student will be able to:

- Understand the fundamentals and dynamics of electric drives
- Develop the rectifier control and chopper control DC drives
- Realize the Concept of AC voltage control, frequency control and slip power recovery control of induction motor drives & Solve Problems
- Know the concept of Synchronous motor drives & Solve Problems

UNIT I: Fundamentals of Electric Drives(6 hours)

Electric Drives, advantages of electric drives, parts of electric drives, choice of electric drives, status of D.C. drives and A.C. drives. starting, Braking, speed control of AC and DC motors

UNIT II: Dynamics of Electric drives (8 hours)

Fundamental torque equations, types of load, Quadrant diagram of speed-Torque characteristics, Dynamics of load torque combinality, steady state stability and Transient stability of an Electric drives. Load equalization. Calculation of time and energy loss in Transient operation, Drive specifications.

UNIT III: Control of dc drives (10 hours)

Controlled rectifier circuits, braking operation of rectifier controlled separately excited dc motor, single phase and three phase half and fully controlled rectifier fed separately excited dc motor ,multi quadrant operation of fully controlled rectifier fed separately excited dc motor. Chopper control of dc drives : chopper control of separately excited and series dc motors , multi quadrant control of chopper fed motors

UNIT IV: Control of Induction Motor Drives AC Voltage Controllers: (10 hours)

Control of induction motor by AC voltage controllers. Frequency controlled Induction motor drives: control of Induction motor by Voltage Source Inverter (VSI),), Current controlled PWM inverters and cyclo converters.Slip power controlled wound-rotor induction motor drives: static rotor resistance control, static scherbius drives, krammer drives

UNIT V: Control of Synchronous Motor Drives (8 Hours)

Operation of cylindrical rotor synchronous motor from VSI and CSI, self controlled Synchronous Motor Drives using cyclo converters, Permanent magnet AC motor drives

Text Books:

1. G.K. Dubey, “Fundamentals of Electrical Drives”, Narosa Publishers, New Delhi. 1988
2. N.K. De and P.K. Sen, “Electrical Drives”, Prentice Hall of India, New Delhi. 1999

Reference Books:

1. Vedam Subrahmanyam, “Thyristor Control of Electrical Drives”, Tata McGraw Hill,

New Delhi. 1988.
2. B.K. Bose “Modern Power Electronics & A.C Drives’.Pearson .edu
3. P.S.Bimbhra “ Power Electronics” Khanna publishers
4. G.K. Dubey, “Power Semiconductor Drives”, Narosa Publishers, New Delhi. 1988

EEPE21	**DIGITAL CONTROL SYSTEMS**	
Externals: 60Marks		**L-T-P-C**
Internals: 40Marks		**3-0-0-3**

Course Objectives:

- This course introduces the concepts of Digital control systems and different types of
- Z-Transforms
- It discusses the design of different controllers, state equations of discrete data systems and stability analysis of discrete systems
- Analyze discrete control systems using z-transforms and stability of discrete control systems
- Design discrete control systems via pole placement
- Design observers for discrete control systems

UNIT I: Introduction To Digital Control Systems And Z-Transforms (9 Hours)

Introduction - Merits and Demerits of Digital Control Systems - Practical aspects of the choice of sampling rate and Multirate sampling - Basic discrete time signals - Quantization – Sampling Theorem - Data Conversions and Quantization - Sampling process - Mathematical Modeling - Data Reconstruction and Filtering of sampled signals - Zero - Order Hold (ZOH). z- Transform and Inverse z-Transform, Relationship between s - plane and z - plane - Difference equation - Solution by recursion and z-Transform - Pulse Transfer Functions of the ZOH and relationship between G(s) and G(z) - Bilinear Transformation .

UNIT II: Input/output Analysis Of Digital Control Systems (8 Hours)

Pulse transfer function - z transform analysis of open loop, closed loop systems - Modified z Transform - transfer function - Stability of linear digital control systems - Stability tests – Jury Stability test. Root loci - Frequency domain analysis - Bode plots - Gain margin and phase margin.

UNIT III: Design Of Controllers For I/O Model Digital Control Systems (9 Hours)

Cascade and Feedback Compensation by continuous data controllers - Digital controllers - Design using Bilinear Transformation - Realization of Digital PID controllers, Design of Digital Control Systems based on Root Locus Technique.

UNIT IV: State Space Analysis And State Feedback Control Design Of Digital Control Systems (9 Hours)

State Equations of discrete data systems, solution of discrete state equations, State Transition Matrix: Computation methods for State Transition Matrix: z - transform method - Relation between State Equations and Pulse Transfer Functions. Concepts on Controllability and Observability - Pole placement design by state feedback.

UNIT V: Digital State Observer And Stability Analysis (6 Hours)

Design of the full order and reduced order state observer, Design of Dead beat Controller - some case studies - Stability analysis of discrete time systems based on Lyapunov approach.

Text Books:

1 K. Ogata, Discrete Time Control Systems, PHI/Addison - Wesley Longman Pte. Ltd., India, Delhi,1995.
2 B.C Kuo, Digital Control Systems, 2nd Edition, Oxford University Press, Inc., 1992.

Reference Books:

1. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems,
2. Addison - Wesley Longman, Inc., Menlo Park, CA , 1998.
3. M. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, India, 1997.
4. C. H. Houpis and G.B. Lamont, Digital Control Systems, McGraw Hill, 1985.
5. John S. Baey, Fundamentals of Linear State Space Systems, McGraw Hill, 1st edition.
7. Dorsay, Continuous and Discrete Control Systems, McGraw Hill.

EEPE22 RELIABILITY ENGINEERING

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**3-0-0-3**

Course Objectives:

- The course covers principles of reliability, failure rate and its relation to reliability, probability distribution of the time to failure, exponential and weibull distributions, reliability of systems, series and parallel systems, stand by redundancy, systems mean time to failure, mean residual life, reliability in design.
- It also includes failure mode effect analysis, failure tree analysis, reliability testing and

analysis, And warranty problems

Course Outcomes: At the end of the course the student will be able to:

- Have a working knowledge of the techniques of reliability engineering
- To apply learned concepts to improving the maintenance, the maintainability, hazard risk and the safety of a plant.
- Develop warranty plans for different products
- To carry out a failure mode effect and criticality analysis.

UNIT I: Basic Probability Theory(9 Hours)

Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.

Definition of Reliability

Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time Between Failures.

UNIT II: Network Modeling And Evaluation Of Simple Systems(8 Hours)

Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems - Series-Parallel systems- Partially redundant systems- Examples.

Network Modeling and Evaluation of Complex systems

Conditional probability method- tie set, Cutset approach- Event tree and reduced event tree methods-Relationships between tie and cutsets- Examples.

UNIT III: Time Dependent Probability(8 Hours)

Basic concepts- Reliability function f(t). F(t), R(t) and h(t) - Relationship between these functions.

Network Reliability Evaluation Using Probability Distributions

Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

UNIT IV: Discrete Markov Chains(6 Hours)

Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation-Limiting State Probability evaluation- Absorbing states –Examples

Continuous Markov Processes

Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems

UNIT V: (8 Hours)

Frequency And Duration Techniques: Frequency and duration concepts, application to multi state problems, Frequency balance approach.

Approximate System Reliability Evaluation: Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

TEXT BOOKS

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press.
2. E.Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited

EEPE31	**HIGH VOLTAGE ENGINEERING**	
Externals: 60Marks		**L-T-P-C**
Internals: 40Marks		**3-0-0-3**

Course Objectives:

- To develop knowledge on generation of high voltage DC, AC (power frequency and high frequency), impulse voltages and currents

- To know the measurement of high voltages DC, AC (power frequency and high frequency), impulse voltages and currents
- To understand thoroughly various high voltage testing techniques of power apparatus and Insulation coordination in power systems

Course Outcomes: At the end of the course the student will be able to:

- Understand breakdown phenomena in gases and to elucidate the concepts used for the generation of high voltages and currents.
- Elucidate the concepts used for the measurement of high voltages and currents and design Corresponding circuits.
- Understand high voltage testing techniques of Power apparatus and causes of over voltage in Power systems.
- Design the layout of Gas Insulated substations and to know the concepts of insulation coordination.

UNIT I: Introduction To High Voltage Technology And Applications (7 Hours)

Electric Field Stresses, Gas / Vacuum as Insulator, Liquid Dielectrics, Solids and Composites, Estimation and Control of Electric Stress, Numerical methods for electric field computation, Surge voltages, their distribution and control, Applications of insulating materials in transformers, rotating machines, circuit breakers, cable power capacitors and bushings.

UNIT II: Break Down in Solid Dielectrics Gaseous and Liquid Dielectrics(8 Hours)

Gases as insulating media, collision process, Ionization process, Townsend's criteria of breakdown in gases, Paschen's law - Liquid as insulator, pure and commercial liquids - breakdown in pure and commercial liquids.

Break Down In Solid Dielectrics
Intrinsic breakdown, electromechanical breakdown, thermal breakdown, breakdown of solid dielectrics in practice, Breakdown in composite dielectrics, solid dielectrics used in practice.

UNIT III: Generation of Measurement High Voltages And Currents(9 Hours)

Generation of High Direct Current Voltages, Generation of High alternating voltages, Generation of Impulse Voltages, Generation of Impulse currents, Tripping and control of impulse generators.
Measurement Of High Voltages And Currents
Measurement of High Direct Current voltages, Measurement of High Voltages alternating and

impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements.

UNIT IV :Non-Distructive Testing Of Material And Electrical Apparatus(7Hours)

Measurement of D.C Resistivity, Measurement of Dielectric Constant and loss factor, Partial discharge measurements.
High Voltage Testing Of Electrical Apparatus: Testing of Insulators and bushings, Testing of Isolators and circuit breakers, testing of cables, Testing of Transformers, Testing of Surge Arresters, and Radio Interference measurements**.**

UNIT V: Over Voltage Phenomenon And Insulation Co-Ordination (7 Hours)

Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, Principles of Insulation Coordination on High voltage and Extra High Voltage power systems.

Text books:

1. M.S.Naidu and V. Kamaraju , High Voltage Engineering by– TMH Publications, 3rd Edition
2 . E.Kuffel, W.S.Zaengl, J.Kuffel , High Voltage Engineering: Fundamentals by Elsevier, 2nd Edition.

Reference books:

3. C.L.Wadhwa , High Voltage Engineering by, New Age Internationals (P) Limited, 1997.
4. Ravindra Arora, Wolfgang Mosch, High Voltage Insulation Engineering by, New Age International (P) Limited, 1995.
5. Mazen Abdel Salam, Hussein Anis, Ahdan El-Morshedy, Roshdy Radwan , Marcel Dekker High Voltage Engineering, Theory and Practice.

EEPE32 DIGITAL SIGNAL PROCESSING

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**3-0-0-3**

Course Objectives: This course will develop student’s knowledge in/on

- continuous-time (CT) and discrete-time (DT) signals
- discrete fourier transform (DFT), computational complexity of DFT and efficient

implementation of DFT using fast fourier transform (FFT)
- specifying characteristics of frequency selective filters, design of linear-phase FIR filters
- classical analog butterworth & chebyshev filters, converting analog filter into equivalent digital filter to design digital IIR filters

Course Outcomes: At the end of the course the student will be able to:

- Represent signals mathematically in continuous and discrete-time, and in the frequency domain.
- Analyse discrete-time systems using z-transform.
- Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms. Design digital filters for various applications.
- Apply digital signal processing for the analysis of real-life signals.

UNIT I: Discrete-time signals and systems (6 hours)

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Samplingand reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

UNIT II: Z-transform (6 hours)

Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

UNIT III: Discrete Fourier Transform (10 hours)

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolutions of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

UNIT IV:Designof Digital filters (12 hours)

Designof FIR Digital filters: Windowmethod,Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations;Low-pass, Band-pass, Band- stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signalprocessing.

UNIT V: Applications of Digital Signal Processing (6 hours)

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Text/Reference Books:

1. S. K. Mitra, " Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing" , Prentice Hall, 1989.
3. J. G. Proakis and D.G. Manolakis, " Digital Signal Processing: Principles, Algorithms And Applications", Prentice Hall, 1997.
4. L. R. Rabiner and B. Gold, "Theory and Application of Digital Signal Processing" , Prentice Hall, 1992.
5. J. R. Johnson, " Introduction to Digital Signal Processing" , Prentice Hall, 1992.
6. D. J. DeFatta, J. G. Lucas andW. S. Hodgkiss, " Digital Signal Processing" , John Wiley & Sons, 1988.

EEPE33 **CONTROL SYSTEM DESIGN**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

- Analysis of properties of control systems, such as sensitivity, stability, controllability, tracking, in time and frequency domains; and
- Design of feedback controllers, such as PID, lead and lag compensators, pole placement designs, to meet desired system performance specifications.
- Understand various design specifications.
- Design controllers to satisfy the desired design specifications using simple controller structures (P, PI, PID, compensators).
- Design controllers using the state-space approach.

UNIT I: Design Specifications (6 hours)

Introduction to design problem and philosophy. Introduction to time domain and frequency domain design specification and its physical relevance. Effect of gain on transient and steady state response. Effect of addition of pole on system performance. Effect of addition of zero on system response.

UNIT II: (14 Hours) Design of Classical Control System in the time domain (8 hours)

Introduction to compensator. Design of Lag, lead lag-lead compensator in time domain. Feedback and Feed forward compensator design. Feedback compensation. Realization of compensators.

UNIT III: (14 hours)
Design of Classical Control System in frequency domain

Compensator design in frequency domain to improve steady state and transient response.
Feedback and Feed forward compensator design using bode diagram.
Design of PID controllers

Design of P, PI, PD and PID controllers in time domain and frequency domain for first, second and third order systems. Control loop with auxiliary feedback – Feed forward control.
UNIT IV: Control System Design in state space (8 hours)

Review of state space representation. Concept of controllability & observability, effect of pole zero cancellation on the controllability & observability of the system, pole placement design through state feedback. Ackerman's Formula for feedback gain design. Design of Observer. Reduced order observer. Separation Principle.

UNIT V: Nonlinearities and its effect on system performance (4 hours)

Various types of non-linearities. Effect of various non-linearities on system performance.
Singular points. Phase plot analysis.

Text and Reference Books :

1. N. Nise, " Control system Engineering", John Wiley, 2000.
2. I. J. Nagrath and M. Gopal, " Control system engineering", Wiley, 2000.
3. M. Gopal, " Digital Control Engineering", Wiley Eastern, 1988.
4. K. Ogata, " Modern Control Engineering", Prentice Hall, 2010.
5. B. C. Kuo, " Automatic Control system" , Prentice Hall, 1995.

J. J. D'Azzo and C. H. Houpis, " Linear control system analysis and design (conventional and modern)", McGraw Hill, 1995.
R. T. Stefani and G. H. Hostetter, "Design of feedback Control Systems", Saunders College Pub, 1994.

EEPE41 **ARTIFICIAL NEURAL NETWORKS AND FUZZY SYSTEMS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

- To introduce the basics of Neural Networks and its architectures.
- To introduce the Fuzzy sets and Fuzzy Logic system components
- To deal with the applications of Neural Networks and Fuzzy systems

Course Outcomes: At the end of the course the student will be able to:

- To understand artificial neural network models and their training algorithms
- To understand the concept of fuzzy logic system components, fuzzification and defuzzification
- Design the layout of Gas Insulated substations and to know the concepts of insulation coordination.

UNIT I: Introduction To Neural Networks and Essentials of Artificial Neural Networks(9 Hours)

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Hodgkin-Huxley Neuron Model, Integrate-and-Fire Neuron Model, Spiking Neuron Model, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN.

Essentials of Artificial Neural Networks

Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules, Types of Application.

UNIT II: Feed forward and Multilayer Feed forward neural networks(9 Hours)

Single Layer Feed Forward Neural Networks: Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem, Limitations of the Perceptron Model, Applications.

Multilayer Feed forward Neural Networks

Credit Assignment Problem, Generalized Delta Rule, Derivation of Back propagation (BP)

Training, Summary of Back propagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT III: (8 Hours)

Associative Memories

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory (Associative Matrix, Association Rules, Hamming Distance, The Linear Associator, Matrix Memories, Content Addressable Memory).

Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms

Storage and Recall Algorithm, BAM Energy Function, Proof of BAM Stability Theorem. Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis, Capacity of the Hopfield Network.

UNIT IV: Classical And Fuzzy Sets(7 Hours)

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT V: Fuzzy Logic System (7 Hours)

Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

Text books:

1. Rajasekharan and Pai, Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications– PHI Publication.
2. Satish Kumar , Neural Networks, TMH, 2004.

Reference books:

1. James A Freeman and Davis Skapura, Neural Networks, Pearson Education, 2002.
2. Simon Hakins, Neural Networks, Pearson Education.
3. C..Eliasmith and Ch. Anderson, Neural Engineering, PHI.

EEPE43 **LINE-COMMUTATED AND ACTIVE PWM RECTIFIERS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Outcomes: At the end of the course the student will be able to:

- Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.
- Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

UNIT I: Multi-Pulse converter(6 Hours)

Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6- pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

UNIT II: Single-phase ac-dc single-switch boost converter

Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

UNIT III: Ac-dc bidirectional boost converter

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

UNIT IV: Isolated single-phase ac-dc flyback converter-I

Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio.

UNIT V: Isolated single-phase ac-dc flyback converter-I

Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.

Text / References:

1. G. De, “Principles of Thyristorised Converters”, Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, “Principles of Power Electronics”, Addison- Wesley, 1991.
3. L. Umanand, “ Power Electronics: Essentials and Applications”, Wiley India, 2009.
4. N. Mohan and T. M. Undeland, “ Power Electronics: Converters, Applications and Design” , John Wiley & Sons, 2007.
5. R. W. Erickson and D. Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2001.

EEPE51 **HVDC TRANSMISSION**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course objectives:

- To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
- To analyze HVDC converters.
- To study about the HVDC system control.
- To analyze harmonics and design of filters.
- To model and analysis the DC system under study state.

Course Outcomes: At the end of the course the student will be able to:

- Identify significance of DC over AC transmission system, types and application of HVDC links in practical power systems.
- Understand operating principles of HVDC systems and control aspects.
- Model AC/DC system and apply protection for HVDC system against transient overvoltage and over currents

UNIT I: Basic Concepts (7 Hours)

Economics & Terminal equipment of HVDC transmission systems: Types of HVDC Links Apparatus required for HVDC Systems**,** Comparison of AC & DC Transmission, Application of DC Transmission System Planning & Modern trends in D.C. Transmission.

UNIT II: HVDC Converters (8 Hours)

Analysis of HVDC Converters
Choice of Converter configuration analysis of Graetz circuit characteristics of 6Pulse&12Pulseconverters Cases of two 3phase converters in star star mode their performance.
Converter & HVDC System Control
Principle of DC Link Control, Converters Control Characteristics, Firing angle control, Current and extinction angle control, Effect of source inductance on the system; Starting and stopping of DC link; Power Control**.**

UNIT III: Reactive Power Control In HVDC and Power Flow Analysis In AC/DC Systems (9 Hours)

Reactive Power Control In HVDC

Reactive Power Requirements in steady state-Conventional control strategies- Alternate control strategies-sources of reactive power-AC Filters shunt capacitors- synchronous condensers.

Power Flow Analysis In AC/DC Systems

Modeling of DC Links - DC Network - DC Converter - Controller Equations Solution of DC load flow P.U. System for D.C quantities- solution of AC-DC Power flow-Simultaneous method-Sequential method.

UNIT IV: Converter Fault & Protection *(7 Hours)*

Converter faults, protection against over current and over voltage in converter station, surge arresters, smoothing reactors, DC breakers, Audible noise-space charge field-corona effects on DC lines-Radio interference.

UNIT V: Harmonics and Filters (8 Hours)

Harmonics

Generation of Harmonics Characteristics of harmonics, calculation of AC Harmonics, Non-Characteristics of harmonics, adverse effects of harmonics Calculation of voltage & Current harmonics

Effect of Pulse number on harmonics

Filters

Types of AC filters, Design of Single tuned filters Design of High pass filters.

Text Books:

1. K.R. Padiyar"HVDC Power Transmission Systems: Technology and system Interactions" New Age International(P) Limited, and Publishers.
2. S.S. Rao"EHVAC and HVDC Transmission Engineering and Practice"

Reference Books:

1. E.W. Kimbark "HVDC Transmission Direct Current Transmission" John Wiley & Sons.
2. S.Kamakshaiah and V.Kamaraju, 'HVDC Transmission', 1 st Edition, Tata McGraw Hill, 2011.
3. E.Uhlmann"Power Transmission by DirectCurrent" B.S.Publications

EEPE52 **SWITCH MODE POWER SUPPLIES**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

- This course introduces the basic concepts of switched mode power supplies, working of SMPS and different types of converters.
- The course discusses multiple output Fly back SMPS, uses of semiconductors in switched mode topology and different types of switched mode variable power supplies.

Course Outcomes: At the end of the course the student will be able to:

- Know the operation of SMPS, importance of semiconductors in SMPS and different types of SMPS
- Analyze different types of converters, the process of Rectification and different types of switched mode variable power supplies
- Switching devices - ideal and real characteristics, control, drive and protection.
- Reactive circuit elements - their selection and design.
- Switching power converters - circuit topology, operation, steady-state model, dynamic model.
- Analysis, modeling and performance functions of switching power converters.
- Review of linear control theory.
- Closed-loop control of switching power converters.
- Sample designs and construction projects.

UNIT I: Reactive circuit elements - their selection and design.: Introduction to DC-DC

converter, Diode Controlled Switches, Reactive components: Inductor, Transformer, Capacitor, Issues related to switches, Energy storage – Capacitor, Energy storage – inductor

UNIT II: Switched Mode Power Conversion (10 Hours)

Equivalent circuit model of the non-isolated DC-DC converters. Isolated converters (forward, Fly back).

Multiple Output Fly back Switch Mode Power Supplies *(6 Hours)*

Introduction, operating Modes, operating principles, Direct off line Flyback Switch Mode Power

Supplies, Fly back converter, snubber network, Problems.

UNIT III: Using Power Semiconductors in Switched Mode Topologies (8 Hours)
Half-Bridge and Full Bridge
Converters, Push-Pull Converter and SMPS with multiple outputs. Choice of switching frequency, The Power Supply Designer's Guide to High Voltage Transistors, Base Circuit Design for High Voltage Bipolar Transistors in Power Converters, Isolated Power Semiconductors for High Frequency Power Supply Applications

UNIT IV: Rectification (7 Hours)

Explanation, Advantages and disadvantages, SMPS and linear power supply comparison, Theory of operation , Input rectifier stage, Inverter stage, Voltage converter and output rectifier, Regulation, An Introduction to Synchronous Rectifier Circuits using Power MOS Transistors

UNIT V: Concept of Zero Voltage switching (ZVS) and Zero current switching (ZCS) (6 Hours)

Resonant Power Supplies;
An Introduction to Resonant Power Supplies, Resonant Power Supply Converters - The Solution for Mains Pollution Problems.

Text Books:

1. "Switch Mode Power Supplies" by Keith H. Billings Taylor Morey- Tata McGraw-Hill Publishing Company, 3rd edition.
2. "Switch Mode Power Supplies", Robert W. Erickson.

Reference Books:

1. Switching Power Supplies A-Z, Second Edition- Sanjaya Maniktala.
2. Steven M. Sandler, Switch Mode Power Supplies, Tata McGraw Hill.

EEPE53 **SMART GRID**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

- This course introduces the basic concepts of a Smart Grid, different types of constraints and different types of communication technologies for Smart Grid
- It introduces different types of Security systems for the Smart grid
- This course discusses the smart metering and distribution system modeling

Course Outcomes: At the end of the course the student will be able to:

- Understand the background for Smart Grid and have knowledge about important Terminologies
- Know about challenges and possibilities related to Smart Meters
- Analyze and perform basic design of Smart Grid electric power systems
- The course discusses the interaction between the power grid and Flexible resources and Smart Meters

UNIT I: The Smart Grid (8 Hours)

Introduction, Ageing Assets and Lack of Circuit Capacity, Thermal Constraints, Operational Constraints, Security of Supply, National Initiatives, Early Smart Grid Initiatives, Active Distribution Networks, Virtual Power Plant, Other Initiatives and Demonstrations, Overview of The Technologies Required for The Smart Grid.

UNIT II: Communication Technologies (10 Hours)

Data Communications: Introduction, Dedicated and Shared Communication Channels, Switching Techniques, Circuit Switching, Message Switching, Packet Switching, Communication Channels, Wired Communication, Optical Fibre, Radio Communication, Cellular Mobile Communication, Layered Architecture and Protocols, The ISO/OSI Model, TCP/IP Communication Technologies: IEEE 802 Series, Mobile Communications, Multi Protocol Label Switching, Power line Communication, Standards for Information Exchange, Standards For Smart Metering, Modbus, DNP3, IEC61850

UNIT III: Information Security For The Smart Grid (8 Hours)

Introduction, Encryption and Decryption, Symmetric Key Encryption, Public Key Encryption, Authentication, Authentication Based on Shared Secret Key, Authentication Based on Key Distribution Center, Digital Signatures, Secret Key Signature, Public Key Signature, Message Digest, Cyber Security Standards, IEEE 1686: IEEE Standard for Substation Intelligent Electronic Devices(IEDs) Cyber Security Capabilities, IEC 62351: Power Systems Management And Association Information Exchange – Data and Communication Security.

UNIT IV: Smart Metering And Demand Side Integration ***(8 Hours)***

Introduction, smart metering – evolution of electricity metering, key components of smart metering, smart meters: an overview of the hardware used – signal acquisition, signal conditioning, analogue to digital conversion, computation, input/output, and communication.
Communication infrastructure and protocols for smart metering- Home area network, Neighbourhood Area Network, Data Concentrator, meter data management system, Protocols for communication. Demand Side Integration- Services Provided by DSI, Implementation of DSI, Hardware Support, Flexibility Delivered by Prosumers from the Demand Side, System Support from DSI.

UNIT V: Transmission And Distribution Management Systems ***(8 Hours)***

Data Sources, Energy Management System, Wide Area Applications, Visualization Techniques, Data Sources and Associated External Systems, SCADA, Customer Information System, Modelling and Analysis Tools, Distribution System Modelling, Topology Analysis, Load Forecasting, Power Flow Analysis, Fault Calculations, State Estimation, Applications, System Monitoring, Operation, Management, Outage Management System, Energy Storage Technologies, Batteries, Flow Battery, Fuel Cell and Hydrogen Electrolyser, Flywheels, Superconducting Magnetic Energy Storage Systems, Supercapacitors.

Text Books:

1. Smart Grid, Janaka Ekanayake, Liyanage, Wu, Akihiko Yokoyama, Jenkins, Wiley Publications, 2012.
2. Smart Grid:Fundamentals of Design and Analysis.James Momoh,Wiley,IEEE Press.,2012.

EEPE62 ELECTRICAL AND HYBRID VEHICLES

Externals: 60Marks	**L-T-P-C**
Internals: 40Marks	**3-0-0-3**

Course Outcomes: At the end of the course the student will be able to:

- Understand the models to describe hybrid vehicles and their performance.
- Understand the different possible ways of energy storage.
- Understand the different strategies related to energy storage systems.

UNIT I: Introduction to Conventional Vehicles and Hybrid Electric Vehicles :(10 hours)

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.
Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II: Hybrid Electric Drive-trains: (6 hours)

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT III: Electric Trains (10 hours)

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV: Energy Storage (9 hours)

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE)

UNIT V: Energy Management Strategies (7 hours)

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.
Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

Text / References:

1. C. Mi, M. A. Masrur and D. W. Gao, " Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, " Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, " Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
4. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

EEPE63 **POWER QUALITY AND FACTS**

Externals: 60Marks **L-T-P-C**

Internals: 40Marks **3-0-0-3**

Course Objectives:

- This course mainly focuses on the various power quality issues, monitoring and the enhancement of the power quality.
- To understand the concept of flexible AC transmission and the associated problems.
- To review the static devices for series and shunt control.
- To study the operation of controllers for enhancing the transmission capability.

Course Outcomes: At the end of the course the student will be able to:

- Understand the characteristics of ac transmission and the effect of shunt and series reactive compensation.
- Understand the working principles of FACTS devices and their operating characteristics.
- Understand the basic concepts of power quality.
- Understand the working principles of devices to improve power quality.

UNIT I: Transmission Lines and Series/Shunt Reactive Power Compensation(10 hours)

Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Thyristor-based Flexible AC Transmission Controllers (FACTS)

Description and Characteristics of Thyristor-based FACTS devices: Static VAR Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch. Configurations/Modes of Operation, Harmonics and control of SVC and TCSC. Fault Current Limiter.

UNIT II: Voltage Source Converter based (FACTS) controllers (8 hours)

Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters, Pulse-Width Modulation for VSCs. Selective Harmonic Elimination, Sinusoidal PWM and Space Vector Modulation. STATCOM: Principle of Operation, Reactive Power Control: Type I and Type II controllers, Static Synchronous Series Compensator (SSSC) and Unified Power Flow Controller (UPFC): Principle of Operation and Control. Working principle of Interphase

Power Flow Controller. Other Devices: GTO Controlled Series Compensator. Fault Current Limiter.

UNIT III: Application of FACTS (4 hours)

Application of FACTS devices for power-flow control and stability improvement. Simulation example of power swing damping in a single-machine infinite bus system using a TCSC. Simulation example of voltage regulation of transmission mid-point voltage using a STATCOM.

UNIT IV: Power Quality Problems in Distribution Systems (4 hours)

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement. Tolerance of Equipment: CBEMA curve.

UNIT V: DSTATCOM (14 hours)

Reactive Power Compensation, Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters. Synchronous Reference Frame Extraction of Reference Currents. Current Control Techniques in for DSTATCOM.

Dynamic Voltage Restorer and Unified Power Quality Conditioner

Voltage Sag/Swell mitigation: Dynamic Voltage Restorer – Working Principle and Control Strategies. Series Active Filtering. Unified Power Quality Conditioner (UPQC): Working Principle. Capabilities and Control Strategies.

Text/References:

1. N. G. Hingorani and L. Gyugyi, " Understanding FACTS: Concepts and Technology of FACTS Systems", Wiley-IEEE Press, 1999.
2. K. R. Padiyar, " FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
3. T. J. E. Miller, " Reactive Power Control in Electric Systems", John Wiley and Sons, New York, 1983.
4. R. C. Dugan, "Electrical Power Systems Quality", McGraw Hill Education, 2012.
5. G. T. Heydt, "Electric Power Quality" , Stars in a Circle Publications, 1991

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES

Course Structure

and

Syllabus

For

B.Tech

METALLURGICAL AND MATERIALS ENGINEERING

w.e.f 2011 – 2012

Rajiv Gandhi University of Knowledge Technologies

Curriculum of Metallurgical and Materials Engg

1/1 Term (Common to all branches):

Subject No.	Subjects for I semester	Pre-requisite	(L-T)-P	Credits
MA1101	Mathematics – I	None	3-0	4
PH1001 CY1001	Physics (Chemistry)	None	3-0	4
HS1001 ME1001	English for Communication (Mechanics)	None	2-2 / (3-0)	3
EE1001 CS1001	Electrical Technology (Programming & Data structures)	None	3-0	4
ME1002 CE1001	Intro. to Manufacturing Process & WSP (Engg. Drawing and Graphics)	None	1-3	3
PH1701 CY1701	Physics Lab (Chemistry Lab)	None	0-3	2
EE1701 CS1701	Electrical Technology Lab (Programming & Data Structures Lab)	None	0-3	2
EA1701	Extra Academic Activity(EAA)-1	None	0-3	P/R
Total load and Credits			12-14 / 13-12	22

Contact hours: 13X2 + 12 = 38 (or 12X2 + 14 = 38)

2/1 Term (Common to all branches):

Subject No.	Subjects for II semester	Pre-requisite	(L-T)-P	Credits
MA1202	Mathematics-2	None	3-0	4
CY1001 PH1001	Chemistry (Physics)	None	3-0	4
ME1001 HS1001	Mechanics (English)	None	(3-0) / 2-2	3
CS1001 EE1001	Programming & Data structures (Electrical Technology)	None	3-0	4
CE1001 ME1002	Engg. Drawing and Graphics or (Intro. to Manufacturing Process & WSP)	None	1-3	3
CY1801 PH1801	Chemistry Lab (Physics Lab)	None	0-3	2
CS1801 EE1801	Programming & Data Structures Lab (Electrical Technology Lab)	None	0-3	2
EA1801	Extra Academic Activity(EAA)-2	None	0-3	P/R
Total load and Credits			13-12 / 12-14	22

Contact hours: 13X2 + 12 = 38 (or 12X2 + 14 = 38)

3/1 Term:

S. No	Subject No.	Subjects for II semester	Pre-requisite	(L-T)-P	Credits
1	CS1301	Database Management Systems (DBMS)	None	5-0	4
2	HS1301	Managerial Economics	None	5-0	4
5	HS1302	Soft Skills	None	4-3	4
4	EA1901	Extra Academic Activity (EAA)-3	None	0-3	P/R
Total load and Credits				14+6	12

Contact hours: 14X2 + 6 = 34

1/2 Term:

Sl. No.	**Subject No.**	**Subject Name**	**Pre-requisite**	**(L+T)-P**	**Credits**
1	MM2101	Thermodynamics	None	3-0	4
2	MM2102	Structure and Property of Materials	None	3-0	4
3	MM2103	Physical Metallurgy	None	3-0	4
4	MA2103	Fourier Analysis and PDE		3-0	4
5	CS2101	Design of Algorithms		3-0	4
6	MM2701	Chemical Metallurgy Laboratory	None	0-3	2
7	MM2703	Physical Metallurgy Laboratory	None	0-3	2
8	HS2101	Human values-1	None	0-3	P/R
Total				**15-9**	**24**

Contact hours: 15X2 + 9 = 39

2/2 Term:

Sl. No.	**Subject No.**	**Subject Name**	**Pre-requsite**	**(L+T)-P**	**Credits**
1	MM2201	Materials Processing	ME1002	3-0	4
2	MM2202	Mechanical Metallurgy	MM2102	3-0	4
3	EC2201	Basic Electronics	None	3-0	4
4	MA2204	Probability and Statistics	None	3-0	4
5	MM2203	Mineral Processing and Non-ferrous Extractive Metallurgy	MM2101	3-0	4
6	MM2801	Materials Testing and Processing Laboratory – 1	ME1002	0-3	2
7	EC2801	Basic Electronics Laboratory	None	0-3	2
8	HS2201	Human values-2	None	0-3	P/R
Total				**15-9**	**24**

Contact hours: 15X2 + 9 = 39

3/2 Term:

S. No	Subject No.	Subjects	Pre-requisite	(L-T)-P	Credits
1	CS2301	Internet Technology		5-0	4
2	HS_60_	HSS Elective I		5-0	4
5	BM_60_	Management Elective I		5-0	4
4	HS2301	Professional development		0-3	P/R
Total load and Credits				15+3	12

Contact hours: 15X2 + 3 = 33

1/3 Term:

Sl. No.	Subject No.	Subject Name	Pre-requisite	(L+T)-P	Credits
1	MM3101	Iron and Steel Making	MM2203	3-0	4
2	MM3102	Corrosion and Environmental Degradation of Materials	MM2101	3-0	4
3	MM3103	Transport Phenomena in Metallurgical Processes	None	3-0	4
4	MM3104	Phase Transformations and Heat Treatment	MM2103	3-0	4
5		Breadth – I		3-0	3
6	MM3702	Corrosion and Protection Laboratory	MM2101	0-3	2
7	MM3704	Heat Treatment of Materials Laboratory	MM2103	0-3	2
Total				**15-6**	**23**

Contact hours: 15X2 + 6 = 36

2/3 Term:

Sl. No.	Subject No.	Subject Name	Pre-requisite	(L+T)-P	Credits
1	MM3201	Materials Characterization	None	3-0	4
2	MM3202	Introduction to Ceramic Technology	MM2102	3-0	4
3	MM3203	Engineering Polymers and Polymer-Matrix Composites	MM2102	3-0	4
4	MM3204	Materials Joining and Particulate Technologies	ME1002	3-0	4
5		Breadth – II		3-0	3
6	MM3801	Materials Characterization Laboratory	None	0-3	2
7	MM3804	Materials Testing and Processing Laboratory - 2	ME1002, MM2202	0-3	2
Total				**15-6**	**23**

Contact hours: 15X2 + 6 = 36

3/3 Term:

S. No	Subject No.	Subjects	Pre-requisite	(L-T)-P	Credits
1	MM3301	Summer Internship		0-40	8
Total load and Credits				0-40	8

1/4 Term:

Sl. No.	**Subject No.**	**Subject Name**	**Pre-requisite**	**(L+T)-P**	**Credits**
1	MM44__	Elective – I/Environmental Impact of Materials and their Processing		3-0	3/4
2	MM44__	Elective - II		3-0	3/4
3	MM44__	Free Elective – I		3-0	3/4
4		Breadth – III		3-0	3
5	MM4700	Project		0-9	6
6	MM4701	Non-Destructive Laboratory	None	0-3	2
Total				**12-12**	**20-23**

Contact hours: 12X2 + 12 = 36

2/4 Term:

Sl. No.	**Subject No.**	**Subject Name**	**Pre-requisite**	**(L+T)-P**	**Credits**
1	MM45__	Elective – III		3-0	3/4
2	MM45__	Elective - IV		3-0	3/4
3	MM45__	Free Elective – II		3-0	3/4
4	HS____	Breadth – IV		3-0	3
5	MM4800	Project		0-9	6
7	MM4801	Project viva			2
8					
Total				**12-12**	**20-23**

Contact hours: 3X2+3X(2X2+1)+ 12 = 33

Note: *At least one of the Breadth courses should be related to Environmental Science and Engg.*

Total no of credits = 2X22+12+2X24+12+2X23+8+2X(20-23) = 210-216

NOTE : L = Lecture T = Tutorial P = Practical

Choice of Electives:

Electives I to IV can be taken from any of the courses being offered from a campus which are expected to be a sub set of the list Electives given here.

Some of the electives also can be taken from the relevant ones from those being from other departments with the approval of the Head of the department.

List of Electives

Sl. No.	Stream	Subject No.	Subject Name	Pre-Requisite	(L+T)-P	Credits
1	Metallurgy	MM4401	Fracture Mechanics and Failure analysis	MM2202	3-0	3
2		MM4402	Furnace Design, Refractory's and Thermal Barrier Coatings	MM3103	3-0	3
3		MM4403	Computational Materials Science	MM2102	3-0	4
4		MM4501	Secondary Steel Making Process	MM3101	3-0	4
5		MM4502	Surface Engineering	None	3-0	3
6		MM4503	Alloy Design and Selection of Materials	MM2102	3-0	3
7	Ceramics	MM4421	Fundamentals of Ceramic Processing	MM3202	3-0	3
8		MM4422	Ceramics for Engineering Applications	MM3202	3-0	4
9		MM4423	Emerging Ceramics	MM3202	3-0	3
10		MM4521	Ceramics for Electronic Applications	MM3202	3-0	4
11		MM4522	Ceramics for structural Applications	MM3202	3-0	3
12		MM4523	Ceramic Matrix Composites	MM3202	3-0	3
13	Polymers and Composites	MM4441	Science and Technology of Polymer Materials	MM3203	3-0	3
14		MM4442	Polymer Blends and Alloys	MM3203	3-0	4
15		MM4443	Manufacture of Industrial Polymers	MM3203	3-0	3
16		MM4541	Technology of Polymer Composites	MM3203	3-0	3
17		MM4542	Advanced Metallic Composites	None	3-0	3
18		MM4543	Advanced Composites	None	3-0	4
19	Special Materials	MM4461	Electrical and Magnetic Materials	MM2102	3-0	3
20		MM4462	Semiconductor Materials	MM2102	3-0	4
21		MM4463	Biomaterials	None	3-0	3
22		MM4561	Nano Materials	None	3-0	4
23		MM4562	Science and Technology of Thin Films	None	3-0	3
24		MM4563	Phase Change Materials	MM3104	3-0	3

Note: The above stream wise classification of subjects is only suggestive and not mandatory.

Requirements for Minor
In
Metallurgical and Materials Engineering

Compulsory courses for all streams:

Sl. No.	Subject Number	Subject Name	Semester	Pre-requisite	(L-T)-P	Credits
1	MM2103	Physical Metallurgy	Autumn	None	3-0	4
2	MM2703	Physical Metallurgy Laboratory	Autumn	None	0-3	2
3	MM2202	Mechanical Metallurgy	Spring	MM2102	3-0	4
4	MM3201	Materials Characterization	Spring	None	3-0	4
5	MM3801	Materials Characterization Laboratory	Spring	None	0-3	2

Metallurgy Stream (any three following theory courses and the associated labs):

Sl. No.	Subject Number	Subject Name	Semester	Pre-requisite	(L-T)-P	Credits
6	MM2101	Thermodynamics	Autumn	None	3-0	4
7	MM2201	Materials Processing	Spring	ME1002	3-0	4
8	MM2802	Materials Testing and Processing Laboratory- 1	Spring	ME1002	0-3	2
9	MM3204	Materials Joining and Particulate Technologies	Spring	ME1002	3-0	4
10	MM3804	Materials Testing and Processing Laboratory- 2	Spring	ME1002	0-3	2
11	MM2203	Mineral Processing and Non-ferrous Extractive Metallurgy	Spring	MM2101	3-0	4
12	MM3101	Iron and Steel Making	Autumn	MM2203	3-0	4
13	MM3104	Phase Transformations and Heat Treatment	Autumn	MM2103	3-0	4
14	MM44_/ MM45_	Any relevant Elective			3-0	3/4

Materials Engineering Stream (any three following theory courses and the associated labs):

Sl. No.	Subject Number	Subject Name	Semester	Pre-requisite	(L-T)-P	Credits
6	MM2102	Structure and Properties of Materials	Autumn	None	3-0	4
7	MM3102	Corrosion and Environmental Degradation of Materials	Autumn	MM2101	3-0	4
8	MM3702	Corrosion and Protection Laboratory	Autumn	MM2101	0-3	2
9	MM3202	Introduction to Ceramic Technology	Spring	MM2102	3-0	4
10	MM4701	Non Destructive Laboratory	Autumn	None	0-3	2
11	MM3202	Engineering Polymers and Polymer Matrix Composites	Spring	MM2102	3-0	4
13	MM44_/ MM45_	Any relevant Elective			3-0	3/4
14	MM44_/ MM45_	Any relevant Elective			3-0	3/4

Rajiv Gandhi University of Knowledge Technologies
Syllabus for
Metallurgical and Materials Engineering

MM2101	Thermodynamics

Importance of Thermodynamics, definition of thermodynamic terms; concept of states, systems equilibrium. Equation of states, extensive and intensive properties, homogeneous and heterogeneous systems.Gibbs phase rule, Phase diagram of a single component system. Internal energy, heat capacity, enthalpy, isothermal, and adiabatic processes.

The Second law of thermodynamics, entropy and free enrgy, degree of reversibility and irreversibility, criteria of equilibrium, auxiliary functions, combined statements, Maxwell's relations, transformation formula, Gibbs-Helmoltz equation.

Concept of Third law, temperature dependence of entropy, statistical interpretation of entropy, Deby and Einstein concept of heat capacity, relation between Cp and Cv, Consequences of third law.

Fugacity, activity, equilibrium constant,chemical potential, use of Y S - functions, controlled atmospheres, homogeneous and heterogeneous equilibria.

Ellingham-Richardson diagrams, phase stability diagrams.

Solution thermodynamics,Solutions, partial molal quantities, ideal and non-ideal solutions, Henry's law, Gibbs - Duhem equation, regular solution, quasi-chemical approach to solution, statistical treatment. Change of standard state. Phase relations and phase rule-its applications. Free energy composition diagrams for binary alloy systems, determination of liquidus, solidus and solvus lines.

Thermodynamics of electrochemical cells, solid electrolytes. Thermodynamics of point defects in solids.

Thermodynamic applications in extraction, refining of metals and materials processing.

MM2102	Structure and properties of Materials

Classification of materials, Atomic structure and interatomic bonding. Lattices, basic ideas of symmentry, unit cells, Atomic packing factor and theoretical density, crystal systems, Bravais lattices.

Structure of crystalline solids. Indexing of directions and planes, notations, co-ordination number. Single crystals, polycrystalline materials, nano-crystalline materials, non crystalline materials.

Imperfections in solids: point defects, 1D, 2D, and 3D defects. Structure, properties, and applications of ceramics, polymers, composites. Structure, properties and applications of functional materials

MM2103	Physical Metallurgy

Phase Diagrams: Various binary phase diagrams, Fe – Fe_3C diagram, introduction to ternary phase diagrams

Elastic behaviour of materials: Constitutive equations in elasticity for isotropic and anisotropic materials, strain energy, elastic stiffness and compliance tensor, effect of crystal structure on elastic constants.

Plastic response of materials-a continuum approach: classification of stress-strain curves, yield criteria.

Microscopic basis of plastic deformation: Elements of dislocation theory, movement of dislocation, elastic properties of dislocation, intersection of dislocation, dislocation reactions in different crystal structures, origin and multiplication of dislocations.

MA2103	Fourier Analysis and PDE

Power series solution of ODE: Frobenius series, Bessel functions and Legendre polynomials

Fourier Series : Periodic functions, Fourier series representation of a function, half range series, sine and cosine series, Fourier integral formula, Parseval's identity.

Fourier Transform: Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties, Self reciprocity of Fourier Transform, convolution theorem

PDE: Introduction to partial differential equations, linear and quasi-linear equations of first order. Classification of integrals. Lagrange's Method of solution and its geometrical interpretation, compatibility condition, Charpit's method, special types of first order equations. Cauchy, Neumann and Dirichlet problems. Fourier series solution of wave equation, vibrations of a string. Riemann's method for hyperbolic equation. Method of separation of variables to solve heat equation, Laplace equation, Diffusion equation.

MM2701	Chemical Metallurgy Laboratory

1. Preparation of lead by reaction of lead (II) oxide with carbon.
2. Preparation of iron by reaction of iron (III) oxide with aluminum (Thermite reaction)
3. Roasting of a sulphide concentrate (FeS , FeS2,ZnS)
4. Formation of aluminum trihydrate and its calcinations to Al2O3

5. Leaching of Al2O3 from A mixture SiC and Al2O3
6. Electroforming of copper on an aluminum mandrel
7. Electrolytic dissolution study of a precipitation harden nonferrous alloy.
8. Making of copper metal from its dissolved copper compounds
9. Electro less plating of copper on the a low carbon steel
10. Oxidation studies of nonferrous metal like copper and ferrous metal like high carbon steel.

MM2703	Physical Metallurgy Laboratory

1. To learn calibration and use of thermocouple and to determine the freezing point of metals and alloys (cooling curves).
2. To study typical macrostructures of few metals (Zn, Al as cast) and alloys and learn the scope and application of macroscopy.
3. Study of optical microscopes.
4. Sample preparation for microscopy
5. To study the microstructures and hardness; pure metals (Fe, Wrought Fe, Zn, Cu and Al).
6. To study the annealed and normalized microstructures of plain carbon steels and different cast irons.
7. To study the effect of cold working (0-90%) and annealing on metallic materials; 50% cold worked metals (Cu, Brass) with respect to temperature and time.
8. Study of various eutectic microstructures (Cu-Cu_2O;Zn-Mg;Cd-Si)

CS2101	Design of Algorithms

MM2201	Materials Processing

Introduction to metal casting, types of metal casting processes, Moulding methods, materials and processes, with special reference to patterns, sand and binders. Solidification of short & long freezing range alloy castings, growth of single crystals, Gating and Risering of castings.

Melting practices for ferrous and non-ferrous alloys-Cupola, rotary furnace, induction furnace, crucible furnace melting. Introduction to cast alloys-classification microstructures and properties of cast irons, plain carbon and Hadfield Manganese steels, Al-Si-alloys. Heat treatment of cast alloys. Casting defects and remedy. Special casting processes.

Metal forming: Classification of metal forming processes, role of temperature and friction in metal working, deformation zone geometry, workability, unit operations in metal forming like rolling, extrusion, sheet metal forming etc.

MM2801	Materials Testing and Processing Laboratory - 1

1. Sieve analysis of molding sand
2. Effects of water/clay ratio on the molding properties of sand
3. To study the effect of CO_2 gassing time on the strengthening characteristics of standard sand specimens prepared with sodium silicate binder
4. Estimation of clay content in molding sand
5. Effect of baking time on the tensile strength of linseed oil-sand mixture
6. Influence of bulk density on properties of molding sand mixtures
7. Melting and casting of steel, Al and Cast iron
8. Characteristics of powders, Compaction in rigid dies, Sintering of metal and ceramic powders

MM2202	Mechanical metallurgy

Introduction: Scope of the subject, elastic, plastic and visco-elastic deformation.

Plastic deformation of single crystals: Critical resolved shear stress, deformation by twinning, deformation band and kink band, strain hardening of single crystal; stress-strain curves of fcc, bcc and hcp materials.

Plastic deformation of polycrystalline materials: Role of grain boundaries in deformation, strengthening by grain boundaries, yield point phenomenon, strain ageing, strengthening by solutes, precipitates, dispersoids and fibres.

Deformation in non-metallic materials: structure and deformation of polymers, concept Super-lattice dislocations in intermetallics, concept of charge associated with dislocations in ceramics.

Hardness - Hardness tests like Brinell, Rockwell, Vickers, Meyer, Knoop, Shore-scleroscope, Poldi & Monotron, relationship with flow curve.

Tension - Engineering & true stress-strain curves, evaluation of tensile properties tensile instability, effect of strain-rate & temperature on flow properties, Compression - Comparison with tension, buckling & barreling. Bending - Pure bending & flexure formula. Torsion - Stresses for elastic & plastic strain, Torsion Vs. Tension.

Impact - Notched bar impact tests, transition Temperature & metallurgical factors affecting it. Creep - Creep, stress rupture & stress relaxation tests, development of creep resistant alloys, prediction of long time properties. Fatigue - Stress cycles & S-N curve, effect of variables like mean stress, stress concentration, surface, size, metallurgical factors etc.

Creep of solids, temperature - stress - strain relationships, deformation mechanisms at elevated temperature, deformation mechanism maps, parametric rel;ationships, materials for elevated temperature.

Cyclic stress-and-strain controlled fatigue, fatigue crack initiation mechanisms, microscopic fracture modes and mechanisms, creep-fatique interation, parameters affecting fatique.

Elements of fracture mechanics, stress analysis of cracks, Linear, elastic and elastoplastic fracture mechanics, Griffith theory, plastic zone size, fracture toughness testing, KIC, COD, J-Integral, fracture toughness on engineering alloys, ceramics and polymers, role of microstructure on fracture toughness.

EC2201	Basic Electronics

Introduction to electronics and electronic systems, Semiconductor and devices like diodes, BJT, FET, MOSFET, Rectifier and Filters, Transistor biasing. Small signal transistor amplifiers, Operational amplifiers, Feedback and Oscillators, Digital circuit and combinational logic, Sequential logic and flip-flops, ADC & DAC, Data acquisition systems, Memory systems, Case studies of electronic systems like microprocessors, radio & TV broadcasting, Mobile & cellular telephones, fiber optics & networking.

EC2801	Basic Electronics Laboratory

MA2204	Probability and Statistics

Probability: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence.

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cummulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev's inequality.

Special Distributions: Discrete uniform, Binomial, Geometric, Poisson, Exponential, Gamma, Normal distributions. Functions of a Random Variable.

Joint Distributions: Joint, marginal and conditional distributions, product moments, correlation, independence of random variables, bivariate normal distribution.

Sampling Distributions: The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions.

Estimation: The method of moments and the method of maximum likelihood estimation, confidence intervals for the mean(s) and variance(s) of normal populations.

Testing of Hypotheses: Null and alternative hypothesis, the critical and acceptance regions, two types of error, power of the test, the most powerful test and Neumann-Pearson Fundamental Lemma, tests for one sample problems for normal populations.

MM2203	Mineral Processing and Non-ferrous Extractive Metallurgy

Mineral dressing: importance of mineral dressing, comminution processes, principles of flotation with case study. Refractories: classification, properties and applications. Newtonian and non-Newtonian fluids, equations of fluid flow, overall energy balance approach for turbulent flow, friction factor. Equations and correlation of convective heat transfer, laws of radiative heat transfer: radiative heat exchange in furnaces containing transparent and absorbing media; conductive heat transfer in solid materials under steady state and unsteady state conditions. Mass transfer by diffusion, general equations of mass transfer with diffusion convection and chemical reaction. Mass transfer co-efficient, mass transfer correlations and their applications; gas solid reaction.

Unit Processes in pyrometallurgy: calcination, roasting, sintering, smelting in shaft furnace, matte smelting, converting, distillation. Metallothermic reduction and hydrogen reduction; refining processes with examples for metals like copper, nickel, lead, zinc, etc. Unit processes in hydrometallurgy: leaching, purification of leach liquor, solvent extraction and ion exchange process, metal recovery from aqueous phase.

Unit processes in electrometallurgy: Faraday's laws of electrolysis, concept of overvoltage, limiting current density, overall cell voltage, series and parallel electrical circuits in refining. Electrowinning and electrorefining with reference to Cu, Zu, Al, Mg.

MM3101	Iron Making and Steel Making

General overview of iron and steel making in India and abroad. General layout of an integrated steel plant. Raw materials in ferrous production metallurgy, coke production, agglomeration of iron ores.

Technology of blast furnace iron making-operational details;effect of external constraints such s high top pressure, burden preparation, fuel injection ect on pig iron production with emphasis on Indian conditions.

Theoretical analysis of blast furnace reactions including gas-solid and slag-metal reactions. Modifications in blast furnace technology. Injection metallurgy pertinent to Blast Furnaces. Alternate methods of reduction of iron.

Fundamentals of Steel making, Historical development of steel making processes. rimary processes - pneumatic and hearth. Secondary Steelmaking. Principles and practice of quality steelmaking, Deoxidation, inclusions.Thermodynamics, kinetics and transport phenomena in steel making. Introduction to ladle metallurgy. Refining of Steel. Continuous Casting.

MM3102	Corrosion and Environmental Degradation of Materials

Technological importance of corrosion study, corrosion as non equilibrium process, corrosion rate expressions, electrochemical principles of corrosion-cell analogy, concept of single electrode potential, reference electrodes, e.m.f. and galvanic series-their uses in corrosion studies, polarization, passivity.

Different forms of corrosion-uniform attack, galvanic, crevice, pitting, intergranular, selective leaching, erosion, stress corrosion cracking-their characteristic features, causes and remedial measures. Principles of corrosion prevention-material selection, control of environment including inhibitors, cathodic and anodic protection, coatings and design considerations. Corrosion testing methods.

Introduction to high temperature corrosion, Pilling-Bedworth ration, oxidation kinetics, oxide defect structures, Wagner-Hauffe valence approach in alloy oxidation, catastrophic oxidation, internal oxidation. Considerations in high temperature alloy design, prevention of high temperature corrosion -use of coatings. Liquid metal attack - liquid metal embrittlement, preventive measures, Chemical degradation of non-metallic materials like rubbers, plastics, ceramics etc. Hydrogen damage-types, characteristics, mechanism and preventive measures.

MM3103	Transport Phenomena in Metallurgical Processes

Fundamentals of heat conduction, convection, radiation and their combined effect; steady and unsteady heat transfer in metallurgical processes, e.g. continuous casting, spray forming, solidification, extrusion etc.

Diffusion and its application in solid state materials processing, convective mass transfer in extraction processes, unsteady diffusion in finite and infinite bodies, diffusion and chemical reaction in porous and nonporous solid.

Newton's law of viscosity, laminar flow problems related to metallurgy, general equation of continuity and motion, application of Bernoulli's equation in flow measuring devices and flow from ladles.

MM3104	Phase Transformation and Heat Treatment

Introduction and classification of phase transformations.Fick's laws of diffusion, solution of Fick's second law and its applications, atomic model of diffusion and role of crystal defects, temperature dependence of diffusion coefficient, Kirkendall effect.

Nucleation and growth theories of vapour to liquid, liquid to solid, and solid to solid transformations; homogeneous and heterogeneous strain energy effect during nucleation; interface-controlled growth and diffusion controlled growth; overall transformation kinetics.

Principles of solidification, stable interface freezing,cellular and dendrite growth,freezing of ingots, nucleation and grain size , segregation, directional solidification, growth of single crystals,evolution of microstructures in pure metals and alloys.

Precipitation from solid solution: types of precipitation reactions, crystallographic description of precipitates, precipitation sequence and age hardening, spinoidal decomposition.
Iron-carbon alloy system: iron-carbon diagram, nucleation and growth of pearlite, cooling of hypo-eutectoid, eutectoid, and hyper-eutectoid steels, development of microstructures in cast irons.

Martensitic Transformations: General characteristics of martensitic reactions, similarity to deformation twinning, bain distortion, crystallography and kinetics of martensitic transformations, examples from ferrous and non-ferrous alloy systems. Order-disorder Transformation: Examples of ordered structures, long and short-range order, detection of super lattices, influence of ordering on properties.

Annealing, normalizing, hardening and tempering of steels; Isothermal and continuous cooling transformation diagrams; Influence of alloying elements on transformation characteristics; Hardenability, Principles of alloying; Introduction to important alloy steels like stainless steels, tool steels, maraging steels, high strength low alloy steels, etc; Surface hardening of steels; Cast irons types, heat treatment and properties. Non-ferrous alloys, Classification, important alloy types, and heat treatment of aluminium alloys, titanium alloys, copper base alloys, super alloys, shape memory alloys, etc.

	Breadth - 1

MM3201	Materials Characterization

Introduction: Scope of subject, classification of techniques for characterization, macro and micro-characterization structure of solids. Bulk averaging techniques: Thermal analysis, DTA, DSC, TGA, dilatometry, resistivity/conductivity.

Optical & X-ray spectroscopy: Atomic absorption spectroscopy, X-ray spectrometry, infrared spectroscopy and Raman spectroscopy.

Metallographic techniques: Optical metallography, image analysis, quantitative phase estimation.

Diffraction methods: X-ray diffraction (crystal systems and space groups, Bravais lattices, direct and reciprocal lattice, Bragg law, powder diffraction and phase identification, single crystal diffraction, structure factor, X-ray crystal structure determination).

Electron optical methods: Scanning electron microscopy and image formation in the SEM.

MM3202	Introduction to ceramic Technology

Bonding, iconicity in ceramics; Crystal Structures in ceramics, Defects and dislocations in ceramics, Diffusion in ceramics, Sintering and grain growth;Phase transformations and strengthening of ceramics. Fracture and toughening mechanism; Electronic properties of ceramics. Non-oxide ceramics and ceramic composites

MM3203	Engineering polymers and Polymer Matrix Composites

Polymers: Polymer as a material basic concepts. Classification of polymers, molecular structure, polymeric isomerism, tacticity, polymer morphology, polymeric elastomers, plastic films, fibres and liquid crystalline polymers, Principles of polymer and copolymer. Kinetics of polymer (step and chain; polymerization techniques (mass, solution, suspension, emulsion, solid state, gas phase); controller of polymer structure and molecular weight; polymer characterization and modification; Polymer solution and polymer melt, crystallinity and inter-chain forces in polymers, solid state properties of polymers; glassy state, high elastic rubbery, state and viscofluid stat e, glass and flow transitions.

Polymer Matrix Composites: Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres – Rovings – Woven fabrics – Non woven random mats – various types of fibres. PMC processes - Hand lay up processes – Spray up processes – Compression moulding – Reinforced reaction injection moulding - Resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GRP).

MM3204	Materials Joining and Particulate Technologies

Introduction to metal joining processes. Metallurgical principles involved in welding of carbon and alloy steels and important nonferrous alloys.

Basic processes in Powder Metallurgy, Characteristics of powders. Compaction in rigid dies. Sintering of metal powders. Application of powder metallurgy products-their relative advantages. Novel processing techniques

	Breadth – II

MM440_	Elective I/ Environmental Impact of materials and their processing

	Breadth – III

HS_____	Breadth – IV

Electives

I. Metallurgy:

1. Fracture mechanics and failure analysis:

Fracture Criteria, Introduction to linear elastic fracture mechanics, Analysis of simple crack problems. Nucleation and propagation of cracks. Correlation between microstructure and fracture behaviour in different materials. Mechanisms of fracture. Evaluation of fracture toughness. Crack behaviour in elastic plastic materials. Effect of strain rate, environments temperature, irradiation etc. on fracture behaviour of materials. Conventional approach to fatigue crack growth in reactive environments static or cyclic loading. Applications of fracture mechanics to materials selection, alloy design, design of structures and failure analysis.

2. Furnace design, Refractories and Thermal Barrier Coatings:

Thermal interactions in furnace. Classification of furnace (application wise), temperature ranges, fuels based service class, burners used. Fuels and fuel preparation for combustion. Design of batch furnaces for specific applications. Continuous furnaces. Furnace capacity and efficiency along with the factors affecting it. Furnace accessories (burners, fan/blower pumps, vacuum pumps). Chimney. Furnace atmosphere & temperature measurement and control. Energy management (Sankey diagram energy audit, recuperators, regenerators). Electric furnace (classification, induction, arc, resistance, plasma) selection and design criteria. Refractories used in furnaces, classification and properties.

3. Computational Materials Science:

4. Secondary steel making process:

5. Surface Engineering:

6. Alloy design and selection of materials:

II.Ceramics:

1. Fundamentals of Ceramic processing:

An overview of Ceramic fabrication processes.

Colloidal processing of ceramics : Types of Colloids, Attractive surface forces. Electrostatic, steric and electrosteric stabilization, Structure of consolidated colloids. Detailed study of rheology of ceramic systems. Particle sol-gel processing.

Forming of Ceramics and Powder Consolidation Method: Characteristics of solid particles; particle shapes, size,equivalent particle diameter, surface area, average particle size, size distribution. Packing of particles, Additives in forming processes, Selection of Additives, Dry pressing, plastic forming, Slip Casting and Tape Casting Methods.Binder removal. Calcination. Alcohxide Sol-gel processing. Thin and thick film processing.

2. Ceramics for Engineering Applications:

High temperature high strength ceramics: Introduction, different types of silicon based ceramics- silicon nitride, silicon carbide, properties, and engineering applications

Porous ceramics for filtration: Introduction, different types of porous ceramics, properties, and applications

Ceramic bearing: Introduction, applicability of ceramic bearing, static load rating of all ceramic bearing, rolling fatigue life of ceramic bearing, fitting of ceramic bearing, application example of ceramic bearing

Cutting tools: Physical properties, different types of ceramics used for cutting tools, cutting performance

Decorative ceramics: Physical properties, different types of ceramics materials and applications

Ceramics materials for energy systems: Li-ion battery, structure of the battery, production process of Li-ion battery, and applications of Li-ion battery

Ceramics for biomedical applications: Introduction, ceramics for artificial joints, ceramics for artificial bones, functional groups effective for apatite nucleation, bioactive cements, ceramics for in situ radiotherapy of cancers

Intelligent ceramics: Design and development: Introduction, self diagnosis function of FRP, application of FRP, self diagnosis function of CMC and applications

3. Emerging Ceramics:

Semiconductive ceramics: PTC thermistors, conduction mechanics, applications, NTC thermistors, conduction mechanism, applications, ceramics varistors ZnO, properties, and applications

Ceramic fuel cells: attractiveness of fuel cells, complications and demands, currently used materials, Cathodes materials, anode materials, interconnects, single chamber fuel cell

Piezoelectric ceramics: background, fabrication, materials and properties, and applications pressure sensor/accelerometers/gyroscopes, piezoelectric vibrators/ ultrasonic transducer, transformers, actuators

Ionic conductor/oxygen sensors: Oxygen sensors for automobiles, ceramics for oxygen sensors used for automobiles, structure and operating principle for oxygen sensors, NOx sensors,

Dielectric ceramic: Classification of the dielectric ceramics, ceramics capacitors, dielectric resonators,

Magnetic ceramic: magnetic function and materials, soft ferrite, applications

Multiferroic- background, fabrication, materials properties, and applications

Optoelectronic ceramic: background, materials, basic properties, optical properties, effects, preparation methods PLZT, YAG, and applications

Superconductive ceramics: Introduction, structure-cubic perovskite and its derivatives, cuprates, properties, fabrication methodology, power applications, high magnetic field generator, electronics devices

Giant magnetoresistive and colossal magnetoresistive ceramic materials

4. Ceramics for Electronic Applications:

Introduction:

Different types of ceramic materials, structure, microstructure, electrical, magnetic, optical and dielectric properties of ceramics, brief applications, electrical conduction, transport mechanism, charge displacement process, defects in crystal, spontaneous polarization

Ceramic Conduction:

High temperature heating elements and electrodes, Ohmic resistors, voltage dependent resistors (varistors), temperature sensitive resistors, fuel cells, ceramic based chemical sensors, introduction to superconductor

Dielectrics and Insulators:

Introduction, dielectric structure, capacitive applications, thermal shock resistance, capacitors, low permittivity ceramic dielectrics and insulators and other different applications

Ceramic Materials:

Piezoelectric ceramics- background, parameters for piezoelectric ceramics and their measurements, characteristics and fabrication, important commercial piezoceramic materials and applications

Pyroelectric materials- background, infrared detection, materials, measurement of pyroelectric coefficient and applications

Electro-optic ceramics- background of optics, Lanthanum substrated PZT, PLZT, applications

Magnetic ceramics- Basic concept of magnetism, model ferrites, properties influencing magnetic behavior, preparation of ferrites and applications

5. Ceramics for Structural Applications:

6. Ceramic Matrix Composites:

Introduction

Definition and overview -Potentialities of CMC-common crystal structures-crystalline and non crystalline ceramics- properties of some ceramics matrix materials –ceramic matrix requirements

Ceramic Fibers for reinforcement

Fine alumina and mullite fibers-SiC fibers- Carbon fibers and whiskers

Processing of monolithic and particulate CMC

Preparation of powders-methods based on solutions and precipitations, vapor phase reactions; Milling, mixing and dispersing, polymer derived ceramics; powder forming processes; activated sintering, combustion sintering, microwave sintering, SPS, pressure assisted sintering, Whisker and fiber reinforced composites

Interface/Interphase technology and approach

Introduction- roles and requirements for fiber interfaces and coatings- Interphase composition: Carbon, Boron Nitride, layered and non layered oxide interfaces- porous and fugitive interfaces

Engineering considerations of coatings and interfaces

Thermodynamic compatibility, Coating process compatibility, Mechanical compatibility Thermal expansion match, Coating strength, Coating adhesion, Strain accommodation, Residual stresses, Component geometry coatability, Environmental stability of coating

Characterization methods

Bulk composite, Fiber reinforcement and matrices: Composition, Density, Porosity, Microstructure, Defects and other physical properties

Mechanical behavior of CMC

Fracture-fatigue and creep behaviors of CMC

NDT evaluation methods

Thermography- Acoustic emission- Radiography- and application

Applications and Case Histories

III. Polymers and Composites:

1. Science and Technology of Polymer materials:

Review of polymers; polymer raw materials ; polymerization principles and processes (step, chain and other polymerizations, polymer kinetics, polymerization techniques); polymer manufacture (unit operations, polymer reactors, polymer isolation, handling and storage); polymer structure and property; polymer characterization; polymer modification, multicomponent polymeric materials (polymer miscibility, polymer blends and alloys, filled plastics, polymer composites); polymer compounding and fabrication (polymer additives, compounding processes, fabrication techniques, post fabrication operations); polymer testing (sample preparation, testing standards and methods, analysis of polymer and additives) ; polymer product design; polymer applications, ; frontiers of polymer materials (biogradable polymers, biomedical polymers, conducting polymers, magnetic polymers, polymers for space, nonlinear optical polymers); problems of polymer (thermoxidative degradation, fire hazards, toxicity, effluent disposal, feedstock scarcity).

2. Polymer blends and Alloy:

Definition, classification and importance of polymer blends and alloys, copolymer vs. polyblends and alloys; concept of polymer miscibility, thermodynamics of polyblends, interchain forces in polyblends, interpenetrating polymer network in polyblends, morphology and phase separation, preparation, processing and properties, characterization techniques, rheology of polyblends and alloys, applications of polyblends and alloys in adhesives, molded products, footwear, films, fibers, tyres and tubes, surface coatings, wire and cable compounds, belting and hoses, miscellaneous uses, current trends in polyblends and alloys technology.

3. Manufacture of Industrial Polymers:

Basic aspect of polymer manufacture, special features of polymerization, control of mol. wt. and MWD, heat transfer from polymer reactor, reactor agitation, reactor fouling, handling and storage of monomers and polymers, safety aspect in polymer manufacture, effluent disposal; technology of commodity polymer manufacture: polyethylene, polypropylene, PVC, polystyrene, polybutadiene and their comonomers, phenolics and amino resins, alkyds and unsaturated polyesters, polyacrylates and allied polymers; technology of engineering polymer manufacture: nylons, polyesters, polycarbonates, epoxy resins, polyurethanes, etc., trends in polymer manufacture : catalyst development, gas phase polymerization, multipurpose reactor, RIM technology, tailored oligomer based technology etc.

4. Technology of Polymer composites:

Fundamental concepts, matrix resins : their synthesis, structure and properties, particulate reinforcing agents : powders, hollow spheres, glass beads etc. both organic and inorganic types, fiber reinforcing agents, short fiber, continuous fiber, glass, polyester, nylon, aramid, carbon and metal fibers and whiskers; sheet reinforcing agents : wood veneer, mica sheets, paper and a-cellulose, woven and nonwoven fabrics; surface and interfaces : surface treatment of reinforcements, coupling agents, adhesion and interfacial forces, hand lay-up, spray coating, prepeg formation, lamination, filament winding, vacuum bag molding, SMC, BMC and DMC, RRIM, RTM ; analysis and testing of composites ; stress-strain behavior and mechanical properties, durability, factors affecting strength of composites, fracture mechanics, debonding and delamination; thermal behavior, failure analysis, applications and case studies.

5. Advanced Metallic Composites:

Introduction

Types of MMCs- Characteristics of MMCs- Potentiality of MMCs- Overview of MMCs

Reinforcements

Continuous fibers– fiber flexibility -Carbon fibers- Boron fibers- Oxide and non oxide fibers – particulates: SiC, Tungsten carbide- Statistical analysis of fiber strength

Matrix materials

Aluminum and its alloys- Titanium alloys- Magnesium and its alloys- Co,Cu,Ni,Ag-Intermetallics-

Processing

Liquid state processing- Casting, Liquid infiltration, Spray co deposition, Insitu processes; Solid state processes: Powder metallurgy processing, extrusion, forging, roll bonding and co-extrusion, diffusion bonding, explosive shock consolidation; gaseous state processing: PVD,

Interface

Crystallographic nature of interface-wettability-mechanical bonding- chemical bonding- interactions at the interface- measurement of interfacial bond strength- bend test, fiber pull out tests

Micromechanics

Elastic constants, strength of materials approach-micromechanical approach: density, coefficient of thermal expansion, thermal conductivity, and thermal stresses in composites

Mechanical behavior of MMC

Fracture-fatigue and creep behaviors of MMC

Applications

Space, automobile, electronic, superconducting magnets, power conductors, sports goods, wear resistant materials

6. Advanced Composites:

Introduction

Definition, origin, physical properties, materials, and applications

Matrix Rasins: Introduction, thermosetting resin- epoxy, phenolic resin, polyimides, norbornene, acetylene, Thermoplastic resins, ordered molecules, molecular composite, Interpenetrating networks, semi-interpenetrating networks, blends

High performance fibers: Introduction, fiber modulus, fiber strength, ultrahigh molecular weight polyethylene, aramid fibers, carbon fiber, s-glass,

Composite mechanical properties: Introduction, lamina properties, laminate properties, and composite compressive strength

Thermoplastic composites: Introduction, high performance thermoplastic matrices, thermoplastic prepreg product forms, processing technology, assembly techniques, and polyarylether salfone

Applications in different fields: Aircrafts- structure, interior components, aircrafts brakes; Ballistics: components for ballistic composite, future opportunities; Space: launch systems, self-contend space modules-commercial and military satellites, spacecrafts, spacecraft, space stations, space sutteles, etc. Racing cars, musical instruments, medical instruments, construction, naval vessels, Sports: golf, tennis rackets, bicycles, skis, fishing rods,

IV. Special Materials:

1. **Electrical and Magnetic Materials:**

Free electron theory, Brillouin zones, Energy bands. Magnetic order, Hund's rules, direct and superexchange interactions. Preparation and characterization of elemental, compound, polycrystalline, single crystal and amorphous semiconductors. Preparation, characterization and properties of BaTiO3, PLZT, PMN ceramics. Relaxors. Hysteresis loops and factors influencing them. Chemical and microstructural aspects of ferrites & processing. Superconductors.

2. **Semiconductor materials:**

3. Bio materials:

4. Nano-materials:

Physics at Nano-scale. Synthesis routes for nano and ultra fine grained materials: bottom up and top down approaches, specific routes such as vapor deposition, sol-gel, rapid solidification processing, high energy ball milling, cryo rolling, and equal channel angular extrusion; Specific nano materials such as carbon nanotubes, semiconducting nanomaterials, magnetic, ferroelectric, multiferroic nanomaterials, nano ceramics, nanomaterials for structural applications, nano biomaterials, and nanocomposites; Charaterization techniques from the perspective of nanomaterials; Properties of nano materials: mechanical and functional; Mechanical behaviour of nanomaterials, and superplasticity; Thermodynamics and stability of nanomaterials; Specific applications of nanomaterials.

Electrical, magnetic, optical, thermal and mechanical properties of nano-structured materials. Applications of naon-materials in molecular electronics, nano-electronics, catalysis, photoelectrochemical cells,photonics, quantum well, quantum dot and quantum wire devices.

5. Science and Technology of Thin films:

Historical development. Fundamentals of vacuum technology, rotary, diffusion, roots blower, turbomolecular, titanium sublimation and cryopumps, low and high vacuum gauges. Thermodynamics and kinetics of thin film growth, nucleation and modes of growth, surface and interface phenomena. Techniques of film deposition; physical vapor deposition, sputtering, various chemical vapor deposition methods, molecular beam epitaxy and liquid phase epitaxy, Langmuir-Blodgett films. Characterization of thin films; structural electrical and optical properties, low angle XRD, LEED and RHEED, ellipsometry, XPS. Applications; semiconductor thin films, hard coatings, barrier layers, optical and infrared windows.

6. Phase change materials:

Books for 1/2Term Courses

Thermodynamics (MM2101):

1. D.R.Gasekell : Introduction to Thermodynamics, Hemisphere Publishing Corpn. McGraw-Hill, 4th Edition, 2003.

Structure and Properties of Materials (MM2102):

1. Materials Science and Engineering, an introduction, by William D. Callister, Jr(John Wiley & Sons, Inc.) Singapore (2003).

2. Materials Science and Engineering-A First Course, by V. Raghavan, 4'th edition, Prentice Hall of India Pvt Ltd., New Delhi, (1998).

Physical Metallurgy (MM2103):

1. Physical Metallurgy by V. Raghavan
2. Physical Metallurgy Principles, by R.E. Read - Hill and R. Abbaschian - (Van Nostrand).