COURSE STRUCTURE

AND

DETAILED SYLLABUS

R18

MECHANICAL ENGINEERING

For

B.TECH. FOUR YEAR DEGREE COURSE

(Applicable for the students admitted into Academic Year 2018-19)

(I – IV Years Syllabus)

RAJIV GANDHI UNIVERSITY OF KNOWLEDGE TECHNOLOGIES

Basar, Nirmal, Telangana - 504107

COURSE STRUCTURE (R18) FOR B.TECH.(REGULAR)

Applicable for the students of B.Tech. (Regular) from the Academic Year 2018-19 and onwards

Course code and Definition:

Course Category	Definitions
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management Courses
PCC	Professional core courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
LC	Laboratory Courses
MC	Mandatory Courses
SI	Summer Industry Internship
PROJ	Project

L : Lecture hours per week
T: Tutorial hours per week
P: Practical hours per week
C: Credits per subject

B.Tech 1st Year

Semester I						
Subject Code	Subject	SSN	L	T	P	C
MA1101	Engineering Mathematics-I	BSC	3	1	0	4
PH1001	Engineering Physics	BSC	3	1	0	4
CE1001	Engineering Graphics	ESC	1	0	4	3
EE1001	Basic Electrical Engineering	ESC	3	1	0	4
HS1001	English	HSMC	2	0	0	2
PH1601	Engineering Physics Lab	BSC	0	0	3	1.5
EE1601	Basic Electrical Engineering Lab	ESC	0	0	2	1
HS1601	English for Communication Lab	HSMC	0	0	2	1
HS1101	Communication Skills – 1		2	0	0	0
	Total		**14**	**3**	**11**	**20.5**

Semester II						
Subject Code	Subject	SSN	L	T	P	C
MA1201	Engineering Mathematics-II	BSC	3	1	0	4
CY1001	Engineering Chemistry	BSC	3	1	0	4
ME1201	Engineering Mechanics	ESC	3	1	0	4
CS1001	Programming for Problem Solving	ESC	3	0	0	3
ME1001	Engineering Workshop	ESC	2	0	2	3
CY1601	Engineering Chemistry Lab	BSC	0	0	3	1.5
CS1601	Programming for Problem Solving Lab	ESC	0	0	4	2
HS1201	Communication Skills-2		2	0	0	0
	Total		**16**	**3**	**9**	**21.5**

B.Tech 2nd Year

Semester III						
Subject Code	Subject	SSN	L	T	P	C
MA2106	Engineering Mathematics-III	BSC	3	1	0	4
EC2104	Basic Electronics Engineering	ESC	3	0	0	3
ME2101	Strength of Materials	PCC	3	1	0	4
ME2102	Thermodynamics	PCC	3	1	0	4
ME2103	Materials Engineering	PCC	3	0	0	3
ME2701	Strength of Materials Lab	PCC	0	0	2	1
ME2702	Materials Engineering Lab	PCC	0	0	2	1
HS2101	Essence of Indian Traditional Knowledge		2	0	0	0
Total			**17**	**3**	**4**	**20**

Semester IV						
Subject Code	Subject	SSN	L	T	P	C
ME2201	Fluid Mechanics and Hydraulic Machines	PCC	3	1	0	4
ME2202	Instrumentation and Control	PCC	3	1	0	4
ME2203	Manufacturing Process	PCC	3	1	0	4
ME2204	Kinematics of Machinery	PCC	3	1	0	4
ME2205	Metrology and Machine Tools	PCC	3	0	0	3
ME2801	Fluid Mechanics & Hydraulic Machinery Lab	PCC	0	0	2	1
ME2802	Metrology and Instrumentation Lab	PCC	0	0	2	1
ME2803	Manufacturing Process Lab	PCC	0	0	2	1
BM0005	Constitution of India		2	0	0	0
Total			**17**	**4**	**6**	**22**

B.Tech 3rd Year

Semester V						
Subject Code	Subject	SSN	L	T	P	C
ME3101	Applied Thermodynamics	PCC	3	1	0	4
ME3102	Dynamics of Machinery	PCC	3	1	0	4
ME3103	Design of Machine Members	PCC	3	1	0	4
ME31xx	Professional Elective-1	PEC	3	0	0	3
ME31xx	Professional Elective-2	PEC	3	0	0	3
ME3701	Applied Thermodynamics Lab	PCC	0	0	2	1
ME3702	Theory of Machines Lab	PCC	0	0	2	1
ME3703	Computer Aided Machine Drawing Practice	PCC	0	0	3	1.5
ME3001	Mini Project-I		0	0	2	1
	Total		**15**	**3**	**9**	**22.5**

Semester VI						
Subject Code	Subject	SSN	L	T	P	C
ME3201	Heat Transfer	PCC	3	1	0	4
ME3202	Design of Transmission Elements	PCC	3	0	0	3
ME32xx	Professional Elective-3	PEC	3	0	0	3
ME32xx	Professional Elective-4	PEC	3	0	0	3
BM3001	Managerial Economics and Financial Analysis	HSMC	3	0	0	3
ME3801	Heat Transfer Lab	PCC	0	0	2	1
ME3802	Computer Aided Engineering Lab	PCC	0	0	3	1.5
BS3201	Environmental Science		3	0	0	0
ME3002	Project – II		0	0	6	3
	Total		**18**	**1**	**11**	**21.5**

B.Tech 4th Year

Semester VII						
Subject Code	Subject	SSN	L	T	P	C
ME4101	Automation in Manufacturing	PCC	3	0	0	3
ME4102	Industrial Engineering	HSMC	3	0	0	3
ME41xx	Professional Elective – 5	PEC	3	0	0	3
XXxxxx	Open Elective – 1	OEC	3	0	0	3
XXxxxx	Open Elective – 2	OEC	3	0	0	3
ME4701	Automation in Manufacturing Lab	PCC	0	0	2	1
ME4001	Project – III		0	0	10	5
	Total		**15**	**0**	**12**	**21**

Semester VIII						
Subject Code	Subject	SSN	L	T	P	C
ME42xx	Professional Elective – 6	PEC	3	0	0	3
XXxxxx	Open Elective – 3	OEC	3	0	0	3
ME4801	Comprehensive Viva	PCC	0	0	0	1
ME4002	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	ME3111	Internal Combustion Engines	V	3-0-0	3
2	ME3112	Non Traditional Manufacturing Process	V	3-0-0	3
3	ME3113	Power Plant Engineering	V	3-0-0	3
4	ME3114	Powder Metallurgy	V	3-0-0	3
5	ME3115	Mechanics of Composite Materials	V	3-0-0	3
6	ME3116	Advanced Mechanics of Solids	V	3-0-0	3
7	ME3117	Mechanical Behavior of Materials	V	3-0-0	3
8	ME3118	Gas Dynamics and Jet Propulsion	V	3-0-0	3
9	ME3119	Bio-Medical Engineering	V	3-0-0	3
3rd Year Sem2					
10	ME3211	Computer Aided Design	VI	3-0-0	3
11	ME3212	Theory of Elasticity	VI	3-0-0	3
12	ME3213	Production Planning & Control	VI	3-0-0	3
13	ME3214	Advanced Fluid Mechanics	VI	3-0-0	3
14	ME3215	Mechanical Vibrations	VI	3-0-0	3
15	ME3216	Micro and Nano Machining	VI	3-0-0	3
16	ME3217	Computational Fluid Dynamics	VI	3-0-0	3
17	ME3218	Conduction and Radiation Heat Transfer	VI	3-0-0	3
4th Year Sem1					
18	ME4111	Refrigeration and Air Conditioning	VII	3-0-0	3
19	ME4112	Tribology	VII	3-0-0	3
20	ME4113	Mechanics of Sheet Metal Forming	VII	3-0-0	3
21	ME4114	Convective Heat And Mass Transfer	VII	3-0-0	3
22	ME4115	Advanced Engineering Thermodynamics	VII	3-0-0	3
23	ME4116	Theory of Combustion and Emissions	VII	3-0-0	3
24	ME4117	Mechanical Handling Systems And Equipments	VII	3-0-0	3
25	ME4118	Phase Transformation and Heat Treatment of Materials	VII	3-0-0	3
26	ME4119	Technology of Surface Coating	VII	3-0-0	3
27	ME4120	Fatigue, Creep and Fracture	VII	3-0-0	3
4th Year Sem2					
28	ME4211	Welding Technology	VIII	3-0-0	3
29	ME4212	Laser Applications in Manufacturing	VIII	3-0-0	3
30	ME4213	Introduction to MEMS	VIII	3-0-0	3
31	ME4214	Experimental Stress Analysis	VIII	3-0-0	3
32	ME4215	Design Optimization	VIII	3-0-0	3

List of Open Electives

Sl. No	Subject Code	Subject	L-T-P	Credits
1	ME4121	Product Design and Development	3-0-0	3
2	ME4122	Finite Element Analysis	3-0-0	3
3	ME4123	Automobile Engineering	3-0-0	3
4	ME4124	Rapid Manufacturing Processes	3-0-0	3
5	ME4221	Fundamentals of Mechatronics Systems	3-0-0	3
6	ME4222	Alternative Sources of Energy	3-0-0	3
7	ME4223	Non Destructive Testing	3-0-0	3

Semester Wise Credits								
Semester	HSMC(12)	BSC(25)	ESC(24)	PCC(48/54.5)	PEC(18)	OEC(18)	Project Work(15)	Total
I Semester	3	9.5	8					20.5
II Semester		9.5	12					21.5
III Semester		4	3	13				20
IV Semester				22				22
V Semester				15.5	6		1	22.5
VI Semester	3			9.5	6		3	21.5
VII Semester	3			4	3	6	5	21
VIII Semester				1	3	3	6	13
Total(RGUKT)	**9**	**23**	**23**	**65**	**18**	**9**	**15**	**162**
%	**6**	**14**	**14**	**40**	**11**	**6**	**9**	

Rajiv Gandhi University of Knowledge Technologies, Basar

Mechanical Engineering Syllabus (R18)

Course Structure for I B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester I						
Subject Code	Subject	SSN	L	T	P	C
MA1101	Engineering Mathematics-I	BSC	3	1	0	4
PH1001	Engineering Physics	BSC	3	1	0	4
CE1001	Engineering Graphics	ESC	1	0	4	3
EE1001	Basic Electrical Engineering	ESC	3	1	0	4
HS1001	English	HSMC	2	0	0	2
PH1601	Engineering Physics Lab	BSC	0	0	3	1.5
EE1601	Basic Electrical Engineering Lab	ESC	0	0	2	1
HS1601	English for Communication Lab	HSMC	0	0	2	1
HS1101	Communication Skills – 1		2	0	0	0
	Total		**14**	**3**	**10**	**20.5**

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

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, 11th 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**: PH1001**

Engineering Physics

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

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

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)

Category: **Engineering Science Course** Subject Code**: CE1001**

Engineering Graphics

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**:EE1001**

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**: HS1001**

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**: PH1601**

Engineering Physics Laboratory

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

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

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**: EE1601**

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**: HS1601**

English for Communication 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/

Course Structure for I B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester II						
Subject Code	Subject	SSN	L	T	P	C
MA1201	Engineering Mathematics-II	BSC	3	1	0	4
CY1001	Engineering Chemistry	BSC	3	1	0	4
ME1201	Engineering Mechanics	ESC	3	1	0	4
CS1001	Programming for Problem Solving	ESC	3	0	0	3
ME1001	Engineering Workshop	ESC	2	0	2	3
CY1601	Engineering Chemistry Lab	BSC	0	0	2	1.5
CS1601	Programming for Problem Solving Lab	ESC	0	0	4	2
HS1201	Communication Skills-2		2	0	0	0
	Total		**16**	**3**	**8**	**21.5**

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

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:**CY1001**

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**: ME1201**

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.
- Attain an introduction to basic machine parts such as pulleys and mass-spring systems.

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.

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

UNIT 4: Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency, Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium, Applications of energy method for equilibrium, Stability of equilibrium.

UNIT 5: Mechanical Vibrations: Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums.

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

Category: **Engineering Science Course** Subject Code**:CS1001**

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**: ME1001**

Engineering Workshop

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

Externals (Practical) : 60 Marks **2 - 0 - 2 - 3**

(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: **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
MA2106	Engineering Mathematics-III	BSC	3	1	0	4
EC2104	Basic Electronics Engineering	ESC	3	0	0	3
ME2101	Strength of Materials	PCC	3	1	0	4
ME2102	Thermodynamics	PCC	3	1	0	4
ME2103	Materials Engineering	PCC	3	0	0	3
ME2701	Strength of Materials Lab	PCC	0	0	2	1
ME2702	Materials Engineering Lab	PCC	0	0	2	1
HS2101	Essence of Indian Traditional Knowledge		2	0	0	0
Total			**17**	**3**	**4**	**20**

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

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**: EC2104**

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, 7^{th} edition, 2009, PEI.

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

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

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: $\boldsymbol{M/I = f/y = E/R,}$ 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 = GΘ/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**: ME2102**

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**: ME2103**

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**: ME2701**

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**: ME2702**

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
ME2201	Fluid Mechanics and Hydraulic Machines	PCC	3	1	0	4
ME2202	Instrumentation and Control Systems	PCC	3	1	0	4
ME2203	Manufacturing Process	PCC	3	1	0	4
ME2204	Kinematics of Machinery	PCC	3	1	0	4
ME2205	Metrology and Machine Tools	PCC	3	0	0	3
ME2801	Fluid Mechanics & Hydraulic Machinery Lab	PCC	0	0	2	1
ME2802	Metrology and Instrumentation Lab	PCC	0	0	2	1
ME2803	Manufacturing Process Lab	PCC	0	0	2	1
BM0005	Constitution of India		2	0	0	0
Total			**17**	**4**	**6**	**22**

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

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**: ME2202**

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**: ME2203**

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**: ME2204**

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**: ME2205**

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**: ME2801**

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**: ME2802**

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**: ME2803**

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 Forging

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
ME3101	Applied Thermodynamics	PCC	3	1	0	4
ME3102	Dynamics of Machinery	PCC	3	1	0	4
ME3103	Design of Machine Members	PCC	3	1	0	4
ME31xx	Professional Elective-1	PEC	3	0	0	3
ME31xx	Professional Elective-2	PEC	3	0	0	3
ME3701	Applied Thermodynamics Lab	PCC	0	0	2	1
ME3702	Theory of Machines Lab	PCC	0	0	2	1
ME3703	Computer Aided Machine Drawing Practice	PCC	0	0	3	1.5
ME3001	Mini Project-I		0	0	2	1
	Total		**15**	**3**	**9**	**22.5**

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

Applied Thermodynamics

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

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

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.

UNIT-4:

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-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**: ME3102**

Dynamics of Machinery

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

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

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**: ME3103**

Design of Machine Members

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

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

Course Outcomes:

1. Apply the knowledge of stress analysis, theories of failure, manufacturing and material science, and ergonomics principles in design of machine elements.
2. Analyze the stress and strain on mechanical components under different loadings; and understand, identify and quantify failure modes for mechanical parts.
3. Design various machine elements such as temporary and permanent fasteners, Mechanical Springs, pressure vessels and IC engine parts such as piston, connecting rod and crank.
4. 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. Approach design problem successfully, and 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 against fluctuating load

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 permanent and temporary joints

riveted and welded joints under direct and eccentric loading Design of cotter and knuckle joints,. Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints, design of power screws and screw jack.

Unit-IV Design of springs and pressure vessels

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

Helical Springs: Whal 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. Thick and thin cylinders.

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

Text Books

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

REFERENCES:

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

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

3. P. Kannaiah, *Machine Design*, 2nd Edition, Scitech Publications. 2012,

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

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**: ME3702**

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**: ME3703**

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
ME3201	Heat Transfer	PCC	3	1	0	4
ME3202	Design of Transmission Elements	PCC	3	0	0	3
ME32xx	Professional Elective-3	PEC	3	0	0	3
ME32xx	Professional Elective-4	PEC	3	0	0	3
BM3001	Managerial Economics and Financial Analysis	HSMC	3	0	0	3
ME3801	Heat Transfer Lab	PCC	0	0	2	1
ME3802	Computer Aided Engineering Lab	PCC	0	0	3	1.5
BS3201	Environmental Science		3	0	0	0
ME3002	Project – II		0	0	6	3
	Total		**18**	**1**	**11**	**21.5**

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

Heat Transfer

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

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

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.
3. Heat Transfer / Holman .J.P/TMH
4. Heat and Mass Transfer –Cengel- McGraw Hill.

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

Design of Transmission Elements

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

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

COURSE OUTCOMES:

- Apply the knowledge of stress analysis, theories of failure, manufacturing and material science, and ergonomics principles in design of machine elements.
- Analyze the stress and strain on mechanical components under different loadings; and understand, identify and quantify failure modes for mechanical parts.
- Design various transmission elements such as Shafts, keys, couplings, Gears, Belt, Chain drives, Bearings, flywheels and clutches.
- 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.
- Approach design problem successfully, and able to take decisions when no unique solution exists.

Unit-I Design of shaft, keys and coupling

Design of keys, shafts – solid, hollow shafts and splined shafts under torsion and bending loads.Design of couplings – Muff and Split Couplings, Flange, Flexible and Marine type of couplings.

Unit-II Design of gear drive

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 Design of belt drive and chain drive

Design of belt drive systems, selection of belts and design of pulleys.Design of chain drives: Power rating of roller chains. Strength of roller chains

Unit-IV Bearing design

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-V Design of flywheel and clutch

Design of solid and rimmed type flywheel,

Requirement of clutch, Principle of clutch, Design of friction clutch- cone, centrifugal, single disc and multi disc clutch.

Text books:

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

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

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

REFERENCES:

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

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

3. P. Kannaiah, Machine Design, 2nd Edition, Scitech Publications. 2012,

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 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 simlvbple 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**: BS3201**

ENVIRONMENTAL SCIENCE

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

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

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**: ME3801**

Heat Transfer Laboratory

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

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

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.

LIST OF EXPERIMENTS

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**: ME3802**

Computer Aided Engineering 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
ME4101	Automation in Manufacturing	PCC	3	0	0	3
ME4102	Industrial Engineering	HSMC	3	0	0	3
ME41xx	Professional Elective – 5	PEC	3	0	0	3
XXxxxx	Open Elective – 1	OEC	3	0	0	3
XXxxxx	Open Elective – 2	OEC	3	0	0	3
ME4701	Automation in Manufacturing Lab	PCC	0	0	2	1
ME4001	Project – III		0	0	10	5
	Total		**15**	**0**	**12**	**21**

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

Automation in Manufacturing

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

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

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**: ME4701**

Automation in Manufacturing Lab

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

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

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.

Course Structure for IV B.Tech (2018-19 Admitted Batch)						
Mechanical Engineering						
Semester VIII						
Subject Code	Subject	SSN	L	T	P	C
ME42xx	Professional Elective – 6	PEC	3	0	0	3
XXxxxx	Open Elective – 3	OEC	3	0	0	3
ME4801	Comprehensive Viva	PCC	0	0	0	1
ME4002	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.	ME3111	Internal Combustion Engines	V	3-0-0	3
2	ME3112	Non Traditional Manufacturing Process	V	3-0-0	3
3	ME3113	Power Plant Engineering	V	3-0-0	3
4	ME3114	Powder Metallurgy	V	3-0-0	3
5	ME3115	Mechanics of Composite Materials	V	3-0-0	3
6	ME3116	Advanced Mechanics of Solids	V	3-0-0	3
7	ME3117	Mechanical Behaviour of Materials	V	3-0-0	3
8	ME3118	Gas Dynamics and Jet Propulsion	V	3-0-0	3
9	ME3119	Bio-Medical Engineering	V	3-0-0	3
		3rd Year Sem2			
10	ME3211	Computer Aided Design	VI	3-0-0	3
11	ME3212	Theory of Elasticity	VI	3-0-0	3
12	ME3213	Production Planning & Control	VI	3-0-0	3
13	ME3214	Advanced Fluid Mechanics	VI	3-0-0	3
14	ME3215	Mechanical Vibrations	VI	3-0-0	3
15	ME3216	Micro and Nano Machining	VI	3-0-0	3
16	ME3217	Computational Fluid Dynamics	VI	3-0-0	3
17	ME3218	Conduction and Radiation Heat Transfer	VI	3-0-0	3
		4th Year Sem1			
18	ME4111	Refrigeration and Air Conditioning	VII	3-0-0	3
19	ME4112	Tribology	VII	3-0-0	3
20	ME4113	Mechanics of Sheet Metal Forming	VII	3-0-0	3
21	ME4114	Convective Heat And Mass Transfer	VII	3-0-0	3
22	ME4115	Advanced Engineering Thermodynamics	VII	3-0-0	3
23	ME4116	Theory of Combustion and Emissions	VII	3-0-0	3
24	ME4117	Mechanical Handling Systems And Equipments	VII	3-0-0	3
25	ME4118	Phase Transformation and Heat Treatment of Materials	VII	3-0-0	3
26	ME4119	Technology of Surface Coating	VII	3-0-0	3
27	ME4120	Fatigue, Creep and Fracture	VII	3-0-0	3
		4th Year Sem2			
28	ME4211	Welding Technology	VIII	3-0-0	3
29	ME4212	Laser Applications in Manufacturing	VIII	3-0-0	3
30	ME4213	Introduction to MEMS	VIII	3-0-0	3
31	ME4214	Experimental Stress Analysis	VIII	3-0-0	3
32	ME4215	Design Optimization	VIII	3-0-0	3

List of Open Electives

Sl. No	Subject Code	Subject	L-T-P	Credits
1	ME4121	Product Design and Development	3-0-0	3
2	ME4122	Finite Element Analysis	3-0-0	3
3	ME4123	Automobile Engineering	3-0-0	3
4	ME4124	Rapid Manufacturing Processes	3-0-0	3
5	ME4221	Fundamentals of Mechatronics Systems	3-0-0	3
6	ME4222	Alternative Sources of Energy	3-0-0	3
7	ME4223	Non Destructive Testing	3-0-0	3

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

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**: ME3112**

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**: ME3113**

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**: ME3114**

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**: ME3115**

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**: ME3116**

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**: ME3117**

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**: ME3119**

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**: ME3211**

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**: ME3212**

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**: ME3213**

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**: ME3214**

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**: ME3216**

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**: ME3217**

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**: ME4111**

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**: ME4112**

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**: ME4113**

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**: ME4114**

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**: ME4115**

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**: ME4116**

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**: ME4117**

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**: ME4118**

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**: ME4119**

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**: ME4120**

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.

Category: **Professional Elective Course** Subject Code**: ME4211**

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**: ME4212**

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**: ME4214**

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**: ME4215**

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.	ME4121	Product Design and Development	3-0-0	3
2	ME4122	Finite Element Analysis	3-0-0	3
3	ME4123	Automobile Engineering	3-0-0	3
4	ME4124	Rapid manufacturing Process	3-0-0	3
5	ME4221	Fundementals of Mechatronics Systems	3-0-0	3
6	ME4222	Alternative Sources of energy	3-0-0	3
7	ME4223	Non Destructive Testing	3-0-0	3

Category: **Open Elective Course** Subject Code**: ME4121**

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**: ME4122**

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**: ME4123**

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**: ME4124**

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.

Category: **Open Elective Course** Subject Code**: ME4221**

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**: ME4222**

Alternative 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

Category: **Open Elective Course** Subject Code**: ME4223**

Non-Destructive 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.