REGULATIONS – 2013

DEPARTMENT OF
MECHANICAL ENGINEERING

CURRICULUM AND SYLLABIS OF

B.E. – MECHANICAL ENGINEERING
COLLEGE VISION

- Transforming lives through quality Education and research with human values.

COLLEGE MISSION

- To maintain excellent infrastructure and highly qualified and dedicated faculty.
- To provide a conducive learning environment with an ambience of humanity, wisdom, creativity and team spirit.
- To promote the values of ethical behavior and commitment to the society.
- To partner with academic, industrial and government entities to attain collaborative research.
DEPARTMENT OF MECHANICAL ENGINEERING

VISION

• Producing globally competitive Mechanical Engineers with social responsibilities.

MISSION

• Imparting quality education by providing excellent Teaching-learning environment.

• Inculcating qualities of continuous learning, professionalism, team spirit, communication skill and leadership with social responsibilities.

• Promoting leading edge research and development through collaboration with academia and industry.

Program Educational Objectives (PEO)

Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

After 3 to 5 years of completion of our graduation our,

1. Graduates will have successful profession in Mechanical or allied Industries or Research/Academics or business enterprise.

2. Graduates will have the attitudes and abilities of leaders to adapt the changing global scenario.
Program Outcomes (PO)

After the successful completion of Mechanical Engineering Program, the graduates will be able to,

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization in Mechanical Engineering to the solution of complex engineering problems.
- Identify, formulate, research literature, and analyze complex problems in Mechanical Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Design solutions for complex Mechanical Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex Mechanical Engineering Problems.
- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Mechanical Engineering activities with an understanding of the limitations.
- Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
### REGULATIONS 2013
### CURRICULUM AND SYLLABI
### B.E. MECHANICAL ENGINEERING
### SEMESTER – I

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TOTAL CREDITS: 26
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COURSE OUTCOMES
The student will
• apply basic grammar in Writing and Speaking.
• prepare formal Letter Writings.
• come out with proper pronunciation.
• speak confidently in interactions.
• develop interest to read any article.

UNIT I
Language Focus: Technical Vocabulary, Word Formation, Concord, Tense (Present).
Writing: Leave Application Letter, Paragraph writing.
Listening: Listening to correct pronunciation of words.

UNIT II
Language Focus: Words often misspelled, Articles, Tense (Past)
Writing: Permission letters (In-plant training/Seminar/Workshop), Chart description.
Listening: Listening to the Sentences with correct stress and Intonation.
Speaking: Situational Conversations.

UNIT III
Language Focus: Compound nouns, Tense (Future), Preposition, Comparative Adjectives.
Listening: Listening to the conversations.
Speaking: One minute speech.

UNIT IV
Language Focus: Modal verbs, Gerund, Infinitives, Voice.
Writing: Writing Instructions, Letters to Editor.
Listening: Listening to the different Tonal Expressions.
Speaking: Giving Opinions.

UNIT V
Language Focus: ‘If’ Conditionals, ‘Wh’ questions, Question Tags.
Writing: Reading and Note - taking
Speaking: Group Discussion.
Reading: ERC, one word questions from the suggested book.

SUGGESTED ACTIVITIES
2. Exercises on gap filling and correction of errors on Concord (Subject – Verb Agreement).
3. Gap filling exercises using the appropriate Tense forms.
4. Exercises on transferring information from Graph to Text – Bar charts, Flow charts.
5. Making sentences using Modal verbs to express probability, compulsion, etc.
6. Exercises on Writing Instructions.
7. Exercises on framing Questions.
8. Other relevant classroom activities.

L: 45 T: 15 TOTAL: 60 PERIODS

BOOK SUGGESTED FOR READING

REFERENCES
SH101        MATRICES AND DIFFERENTIAL CALCULUS        L T P C
(Common to all B.E. / B.Tech., Degree Programmes)  3 1 0 4

COURSE OUTCOMES

- Ability to find inverse and integral powers of matrices and to perform transformations of matrices.
- Ability to find the evolutes of various curves.
- Ability to solve ordinary and partial differential equations.
- Ability to obtain constrained maxima and minima.

UNIT I  MATRICES  12
Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties (excluding proofs); Cayley – Hamilton theorem (excluding proof) – Inverse and integral powers of a matrix using Cayley – Hamilton theorem; Diagonalisation of a matrix by orthogonal transformation; Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II  DIFFERENTIAL CALCULUS  12
Curvature in cartesian, parametric and polar forms; Centre, radius and circle of curvature; Evolutes.

UNIT III  FUNCTIONS OF SEVERAL VARIABLES  12
Partial derivatives; Total derivatives; Differentiation of implicit functions; Jacobians; Maxima and Minima - Method of Lagrangian multipliers.

UNIT IV  ORDINARY DIFFERENTIAL EQUATIONS  12
Higher order linear differential equations with constant coefficients; Method of variation of parameters; Cauchy’s and Legendre’s linear equations; Simultaneous first order linear equations with constant coefficients.

UNIT V  PARTIAL DIFFERENTIAL EQUATIONS  12
Formation of partial differential equations; Lagrange’s linear equations; Solutions of standard types of first order partial differential equations; Linear partial differential equations of second and higher order with constant coefficients.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES

SH102        APPLIED PHYSICS        L T P C
(Common to all B.E. / B.Tech., Degree Programmes)  3 0 0 3

COURSE OUTCOMES
The students will be able to

- gain knowledge on the properties of matter and hydrodynamics.
- study and apply the ultrasonic methods for industrial and medical field.
- understand Lasers and to identify the appropriate Laser technique for industrial and medical field.
- understand the different types, fabrication, losses of optical fibers and the applications of fiber optics in communication and instrumentation.
- understand the physical properties of photons and electrons and to study the different Electron Microscopes.

UNIT I PROPERTIES OF MATTER AND HYDRODYNAMICS 9

Properties of Matter
Stress, Strain, Hooke’s law; Types of moduli of elasticity; Torsional pendulum – Determination of Rigidity modulus of a wire; Bending of beams – Expression for bending moment – Measurement of Young’s modulus by uniform and Non-uniform bending – I Shaped girders.

Hydrodynamics
Stream line flow, Turbulent flow, Poiseuille’s formula for flow of liquid through a capillary tube, Determination of coefficient of viscosity of a liquid.

UNIT II ULTRASONICS 9


UNIT III LASERS 9

Principle of spontaneous emission and stimulated emission, Population inversion, Pumping, Einstein’s A and B coefficients – derivation; Types of Lasers - CO₂ Laser, Nd-YAG Laser, Semiconductor Laser (Homojunction); Determination of wavelength of Laser using grating and Particle size; Applications of Lasers: Industrial applications – Welding, Cutting and Heat treatment; Medical applications; Holography (construction and reconstruction).

UNIT IV FIBER OPTICS AND ITS APPLICATIONS 9

Principle and propagation of light in optical fibers; Numerical aperture and Acceptance angle; Types of optical fibers – material, refractive index and mode; Double crucible technique of fiber drawing; Splicing – fusion splicing; Loss in optical fiber – attenuation, dispersion and bending; Fiber optical communication system (Block diagram); Advantages and Applications of optical fiber; Fiber optic sensors – temperature and displacement; Endoscope.

UNIT V QUANTUM PHYSICS AND MICROSCOPY 9

Black body radiation – Planck’s theory (derivation) – Deduction of Wien’s displacement law and Rayleigh Jean’s Law from Planck’s theory; Photoelectric effect – Law of Photoelectric effect – Photoelectric equation; Matter Waves – De Broglie wavelength - Schrodinger’s wave equation – time independent and time dependent equations – Particle in one dimensional box; Heisenberg’s Uncertainty principle; Linear Harmonic oscillator; Electron microscope – scanning electron microscope – transmission electron microscope.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
SH103      ENGINEERING CHEMISTRY         L T P C
(Course Common to all B.E. / B.Tech., Degree Programmes)                           3  0  0  3

COURSE OUTCOMES
The students will be able to

• select suitable water treatment techniques for industrial and domestic purpose.
• acquire knowledge of electrochemistry.
• apply the contextual knowledge of adsorption techniques for industrial applications.
• synthesize polymers for domestic and industrial applications.
• understand the knowledge of nano materials for their applications in Science and Engineering.

UNIT I  WATER TREATMENT 9

UNIT II ELECTRO ANALYTICAL TECHNIQUES 9
Electrode potential: definition, measurement of electrode potential, Nernst equation – problems; EMF: definition, measurement of EMF – Poggendorff’s method; reference electrode: standard hydrogen electrode, calomel electrode, glass electrode – measurement of pH using glass electrode; CO₂ sensing electrode; conductometric titrations: acid-base titration (HCl vs NaOH); potentiometric titrations: redox titration (Fe²⁺ vs K₂Cr₂O₇), precipitation titration (Ag⁺ vs NaCl).

UNIT III CATALYSIS AND SURFACE PHENOMENA 9
Types of catalysis – homogeneous catalysis – heterogeneous catalysis, mechanism of catalytic action - contact theory, catalytic promoters, catalytic poison; enzyme catalysis: Michaelis-Menton equation; adsorption: definition, types – physical adsorption – chemical adsorption – differences between physical and chemical adsorption; adsorption isotherms: definition, Freundlich and Langmuir adsorption isotherms, applications of adsorption.

UNIT IV ENGINEERING POLYMERS 9

UNIT V NANO MATERIALS 9
Nanoparticles: definition, carbon nanotubes (CNT), types of carbon nano tubes – single walled and multi walled carbon nanotubes – fullerene; synthesis of carbon nanotubes: chemical vapour deposition – laser ablation – arc-discharge method; properties of CNT: mechanical, electrical, thermal and optical properties; applications of carbon nanotubes in chemical field, medicinal field, mechanical field and current applications.

TOTAL: 45 PERIODS

TEXT BOOKS
REFERENCES
SH104        FUNDAMENTALS OF COMPUTING AND PROGRAMMING IN C  L T P C  3 0 0 3
(Common to all B.E. / B.Tech., Degree Programmes)

COURSE OUTCOMES

• Learn the major components of a computer system.
• Formulate the algorithms and analyze their complexity.
• Identify the correct and efficient ways of solving problems.
• Acquire knowledge about dynamic memory allocation, modular programming and data organization.
• Develop real time applications using the power of C language features.

UNIT I  COMPUTER FUNDAMENTALS  10
Classification of Computers – Basic Computer organization – Number Systems – Problem Analysis –

UNIT II  BASIC C PROGRAMMING  9
Structure of C Program – Keywords, Constants, Variables and Data Types – Operators and Expressions –
Managing Input and Output operators – Decision Making – Branching and Looping.

UNIT III  FUNCTIONS, ARRAYS AND POINTERS  9
Functions: User-defined functions – Definitions – Declarations - Call by reference – Call by value.
Arrays: Declaration – Definition – Multidimensional Arrays – Functions with array as arguments.
Pointers: Initialization – Pointers as Arguments – Pointers to Pointers – Dynamic Memory Management Functions.

UNIT IV  STRUCTURES AND UNIONS  9
Derived types – Structures: Declaration – Definition – Initialization of structures – Accessing structures –
Nested structures – Arrays of structures – Structures and functions – Pointers to structures – Self-
referential structures – Unions.

UNIT V  FILE HANDLING  8

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
SH105 ENGINEERING GRAPHICS L T P C
(Common to all B.E. / B.Tech., Degree Programmes) 2 3 0 4

COURSE OUTCOMES

• Students will be able to use the drawing instruments effectively.
• An ability to draw the basic engineering curves and problems related to projections of points, straight lines, planes and solids.
• Able to apply the knowledge acquired on practical applications of sectioning and development of solids.
• Able to draw simple solids and its sections in isometric view and projections and also to draw its perspective views.

Drawing Instruments – IS specifications on lines – drawing sheets – Printing letters and dimensioning – scales (not for examination) – First angle projection should be followed.

UNIT I  PLANE CURVES 12
Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloids – Epi and Hypo cycloids - construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT II  PROJECTION OF POINTS, LINES AND PLANE SURFACES 12
Projection of points and straight lines located in the first quadrant – Traces – Determination of true lengths and true inclinations.
Projection of regular polygonal surfaces and circular lamina inclined to any one reference plane.

UNIT III  PROJECTION OF SOLIDS 12
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

UNIT IV  SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12
Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – obtaining true shape of section.
Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinder and cone – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V  ISOMETRIC AND PERSPECTIVE PROJECTIONS 12
Perspective projection of prisms, pyramids and cylinders by visual ray method and vanishing point method.

TOTAL: 60 PERIODS

Note: In end semester examination from each unit one question with either or pattern may be asked. No short questions.

TEXT BOOK

REFERENCES
COURSE OUTCOMES

- Acquire logical thinking and problem solving skills.
- Implement the algorithms and analyze their complexity.
- Identify the correct and efficient ways of solving problems.
- Acquire hands on practice in dynamic memory allocation, modular programming and data organization.
- Implement real time applications using the power of C language features.

LIST OF EXPERIMENTS

1. Solve problems such as temperature conversion, student grading, interest calculation.
2. Finding the 2’s complement of a binary number.
3. Generation of the first ‘n’ terms of the Fibonacci sequence and prime sequence.
5. Given distance traveled by a vehicle as $d = ut + \frac{1}{2}at^2$, where ‘u’ and ‘a’ are the initial velocity and acceleration. Calculate the distance traveled for different time intervals.
6. Solving the roots of a quadratic equation.
7. Designing a simple arithmetic calculator. (Use switch statement)
8. Performing the following operations: (Use loop statement)
   i. Generate Pascal’s triangle.
   ii. Construct a Pyramid of numbers.
9. Performing the following operations to a string:
   i. To insert a sub-string into main string at a given position.
   ii. To delete ‘n’ characters from a given position in a string.
   iii. To replace a character of string either from beginning or ending or at a specified location.
10. Performing the following operations: (Use arrays)
    i. Matrix addition.
    ii. Transpose of a matrix.
    iii. Matrix multiplication by checking compatibility.
11. Performing the following operations: (Use recursive functions)
    i. To find the factorial of a given integer.
    ii. To find the GCD (Greatest Common Divisor) of two given integers.
    iii. To solve Towers of Hanoi problem.
12. Performing the Student Information Processing using File Handling concepts.

TOTAL: 45 PERIODS

SOFTWARE REQUIREMENTS

- Turbo C / ANSI C Compiler
- Gcc compiler
SH107 PHYSICS AND CHEMISTRY LABORATORY – I (Common to all B.E. / B.Tech., Degree Programmes) 

PART A – PHYSICS LABORATORY – I

COURSE OUTCOMES
At the end of the Laboratory classes, the students are able to
- develop collaborative learning skills and to add some of their own ideas to the experiments and their explanations.
- understand the optical properties, mechanical properties and electrical properties.

LIST OF EXPERIMENTS
1. (a) Particle size determination using Diode Laser.
   (b) Determination of Laser parameters – Wavelength, and angle of divergence.
   (c) Determination of Numerical aperture and acceptance angle of an optical fiber.
2. Determination of thickness of a thin wire – Air wedge method.
3. Determination of velocity of sound and compressibility of the liquid – Ultrasonic Interferometer.
5. Determination of Young’s modulus – Non-uniform bending method.
7. Determination of specific resistance of a given coil of wire – Carey Foster’s Bridge.
   *A minimum of FIVE experiments shall be offered.*

PART B - CHEMISTRY LABORATORY – I

COURSE OUTCOMES
The student
- can estimate the amount of hardness and acidity present in the water sample.
- gain knowledge about the estimation of nickel in an alloy.
- quantify the electrolyte by measuring the conductance and pH.

LIST OF EXPERIMENTS
1. Estimation of hardness of Water sample by EDTA method.
2. Estimation of acidity of Water sample.
3. Estimation of Nickel by EDTA method.
4. Conductometric titration (HCl Vs NaOH).
5. Conductometric titration (BaCl₂ Vs Na₂SO₄).
6. pH metric titration (HCl Vs NaOH).
7. Determination of molecular weight and degree of polymerization using Viscometry.
   *A minimum of FIVE experiments shall be offered.*
   *Laboratory classes on alternate weeks for Physics and Chemistry.*

TOTAL: 45 PERIODS
SH108 ENGINEERING PRACTICES LABORATORY  
(Common to all B.E. / B.Tech., Degree Programmes) 

L T P C  
0 0 3 2

COURSE OUTCOMES

- Students will be able to prepare the pipe connections and identify the various components used in plumbing.
- An ability to prepare simple wooden joints using wood working tools.
- An ability to prepare simple lap, butt and tee joints using arc welding equipments.
- An ability to prepare simple components using lathe and drilling machine.

PART A – MECHANICAL AND CIVIL ENGINEERING PRACTICES

I PLUMBING WORKS: 5
Study of components related to plumbing.
Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

II CARPENTRY PRACTICES: 6
Study of the joints in roofs, doors, windows and furniture.
Hands-on-exercise:
Wood work, joints by sawing, planning and cutting.

III WELDING: 5
Study of the tools used in welding Gas welding practice.
Preparation of butt joints, lap joints and tee joints using arc welding.

IV BASIC MACHINING: 7
(a) Simple Turning and Taper turning.
(b) Drilling Practice.

REFERENCES
PART B – ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICES

COURSE OUTCOMES

• An ability to develop familiarity with rudimentary measurement equipment – signal generators, oscilloscopes, multimeters and power supplies.
• Ability to demonstrate and evaluate the parameters of basic electronic components (wires, resistors, capacitors, diodes etc.) based on their physical parameters and dimensions.
• Define, describe, and analyze fundamentals of Boolean algebra and digital logic gates.
• An ability to predict qualitatively and quantitatively compute the steady state AC responses of basic circuits using the phasor method.
• Gain experience in the documentation of measurements and procedures as well as the preparation of formal reports.

I ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
5. Measurement of energy using single phase energy meter.

II ELECTRONICS ENGINEERING PRACTICE

1. Study of Electronic components and equipments – Resistor, colour coding, measurement of AC signal parameters (peak-peak, rms period, frequency) using CRO
2. Study of logic gates AND, OR, XOR and NOT.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 45 PERIODS

REFERENCES

13A20 TECHNICAL ENGLISH – II
(Common to all B.E. / B.Tech., Degree Programmes)

COURSE OUTCOMES
The student will be able to
- apply correct form of language while Speaking and Writing.
- prepare his own Professional letter writings.
- interpret any passage after listening.
- interact at different situations fluently.

UNIT I
Language Focus: Homonyms, Different grammatical forms of the same word, correct usage of words / phrases.
Writing: Recommendation writing.
Listening: Interpreting Poetic lines.
Speaking: Telephone English.

UNIT II
Language Focus: Cause and Effect, Phrasal Verbs.
Listening: Conversations.
Speaking: Asking questions.

UNIT III
Language Focus: Idioms and Phrases with animal names.
Writing: Checklist, Process Description.
Speaking: Presentations.

UNIT IV
Language Focus: Technical Definitions, Transformation of Sentences.
Writing: Job Application Letter, Curriculum Vitae, Bio-data, Resume.
Speaking: Mock Interview.

UNIT V
Language Focus: British and American Vocabulary, Numerical Expressions.
Writing: E-mail Writing, Report Writing.
Speaking: Group Discussion.

SUGGESTED ACTIVITIES
1. Making sentences using different grammatical forms of the same word.
2. Exercises on combining sentences using Cause and Effect expressions.
4. Writing exercises on Recommendations.
5. Exercises on Idioms and Phrases.
7. Exercises on British and American English words with meanings.

TOTAL: 45 PERIODS

BOOK SUGGESTED FOR READING
REFERENCES

13A21 INTEGRAL CALCULUS AND TRANSFORMS  
(Common to all B.E. / B.Tech., Degree Programmes)  

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COURSE OUTCOMES

- Ability to find area and volume of objects using double and triple integrals.
- Ability to analyze the concepts related to vector calculus and to apply them in engineering field.
- Ability to perform the ideas of Laplace transform and Z-transform in their respective engineering subjects.

UNIT I MULTIPLE INTEGRALS 12
Double integration – Cartesian and polar coordinates; Change of order of integration; Change of variables between cartesian and polar coordinates; Triple integration in cartesian coordinates; Area as double integral; Volume as triple integral.

UNIT II VECTOR CALCULUS 12
Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields; Vector integration – Green’s theorem in a plane, Gauss divergence theorem and Stoke’s theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT III LAPLACE TRANSFORM 12

UNIT IV INVERSE LAPLACE TRANSFORM 12
Definition of Inverse Laplace transform – Convolution theorem – Solution of linear ordinary differential equations of second order with constant coefficients using Laplace transformation techniques and solution of simultaneous differential equations of first order with constant coefficients using Laplace transformation techniques.

UNIT V Z – TRANSFORM 12

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES
The Student will

• identify the crystal lattices, their structures and how the structure influences its major properties at different levels.
• choose the major functional and structural properties required for specific applications of conducting materials
• check the parameters that satisfy the superconducting behaviours.
• relate technology to the physics of semiconductor devices.
• understand the physics underlying the magnetic behaviour of materials.
• Explain the mechanism by which electric field interacts with materials and their applications
• suggest materials based concepts to improve the properties and performance under given circumstances.

UNIT I CRYSTAL PHYSICS
Lattice, Unit cell, Bravais lattice, Lattice planes; Miller indices – d-spacing in cubic lattice; Calculation of number of atoms per unit cell, Atomic radius, Coordination number and Packing factor for SC, BCC, FCC and HCP structures; Crystal defects – point, line and surface defects; Burger vector.

UNIT II CONDUCTING MATERIALS AND SUPERCONDUCTORS
Conductors

Superconductors
Superconductivity: Properties – Meissner effect – Isotopic effect; Types of super conductors – Type I and Type II superconductors; Applications of superconductors – Magnetic levitation.

UNIT III SEMICONDUCTORS
Intrinsic semiconductor – carrier concentration derivation – Fermi level – variation of Fermi level with temperature – electrical conductivity – bandgap determination; Extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration; Hall effect – Determination of Hall coefficient – Applications.

UNIT IV MAGNETIC MATERIALS AND DIELECTRIC MATERIALS
Magnetic materials

Dielectric materials
Electrical susceptibility, dielectric constant, Types of Polarization – electronic, ionic, orientation and space charge polarization – frequency and temperature dependence of polarization; Internal field – Clausius-Mosotti relation (derivation); dielectric loss, dielectric breakdown, Uses of dielectric materials in capacitor and transformer.

UNIT V NEW ENGINEERING MATERIALS
Metallic glasses: preparation, properties and applications; Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA; Nano materials: synthesis – chemical vapor deposition – sol-gels – ball milling; properties of nano particles.
and applications; Solar cell – PN junction solar cell – Conversion efficiency and solar concentration – Hetero junction solar cell; Classification of Biomaterials and its applications.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES

The students can
- apply thermodynamic concepts for the given thermal system.
- apply the concept of phase rule for the manufacture of engineering materials.
- extend and deepen the knowledge on different types of fuels and flue gas composition.
- select proper engineering materials for desired engineering application.
- choose proper analytical technique to analyse the engineering material.

UNIT I    THERMODYNAMICS                             9
Terminology; internal energy – zeroth law; first law of thermodynamics: mathematical form of first law – limitations; reversible isothermal expansion of an ideal gas; heat capacity: definition, relationship between \( C_v \) and \( C_p \); Kirchoff’s equation; enthalpy; entropy: entropy change in reversible and irreversible process; free energy: Gibbs free energy – Helmholtz work function; second law of thermodynamics; Gibbs-Helmholtz equation – derivation – problems; Van’t-Hoff isotherm: Derivation – Van’t-Hoff isocore – problems.

UNIT II   PHASE RULE AND POWDER METALLURGY                  9

UNIT III  FUELS AND COMBUSTION                                  9

UNIT IV    ENGINEERING MATERIALS                9
UNIT V ANALYSIS OF MATERIALS 9
Microscopic analysis: Scanning Electron Microscopy (SEM): principle – instrumentation (block diagram only) – applications; Tunneling Electron Microscopy (TEM): principle – instrumentation (block diagram only) – applications; thermogravimetry (TG): definition, instrumentation (block diagram only), characteristics of thermogram, factors influencing thermogravimetry, analyzing limestone thermogram, applications; Atomic Absorption Spectroscopy (AAS): principle – instrumentation (block diagram only), estimation of nickel by AAS; flame photometry: principle – instrumentation (block diagram only), estimation of sodium by flame photometry.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
13A24      ENGINEERING MECHANICS  
(Common to Mechanical and Civil)  L T P C  
3 1 0 4  

COURSE OUTCOMES  
• An ability to use the basic concept of force systems and solve problems.  
• An ability to implement the knowledge acquired in supports, reactions, equilibrium of rigid 
  bodies for solving problems.  
• The students gain an ability to predict centre of gravity, moment and product moment of 
  inertia of simple configurations.  
• An ability to solve practical problems on Projectiles, Newton’s laws, work-energy and 
  impulse momentum.  
• An ability to apply the principles of friction and rigid body dynamics to analyze and solve 
  problems.  

UNIT I  BASICS AND STATICS OF PARTICLES  12  
Introduction – Units and Dimensions – Laws of Mechanics – Lame’s theorem, Parallelogram and 
triangular Law of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in 
space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force – 
Vectorial representation of forces.  

UNIT II  EQUILIBRIUM OF RIGID BODIES  12  
Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – 
Moments and Couples – Moment of a force about a point and about an axis, Vectorial representation of 
moments and couples – Scalar components of a moment – Varignon’s theorem – Equilibrium of 
Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.  

UNIT III  PROPERTIES OF SURFACES AND SOLIDS  12  
Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, 
circle, triangle from integration – T section, I section – Angle section, Hollow section by using standard 
formula – second and product moments of plane area – Rectangle, triangle, circle from integration 
– T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem 
and perpendicular axis theorem.  

UNIT IV  DYNAMICS OF PARTICLES  12  
Displacements, Velocity and acceleration, their relationship – Projectile motion – Newton’s law – Work 
Energy Equation of particles – Impulse and Momentum.  

UNIT V  FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS  12  
Frictional force – Laws of Coulomb friction – Simple contact friction – Rolling resistance – Belt friction – 
Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.  
L: 45   T: 15    TOTAL: 60 PERIODS  

TEXT BOOK  

REFERENCES  
COURSE OUTCOMES

• Describe the basic concepts of electric circuits and measuring instruments.
• Discuss the principle of electrical machines.
• Summarize the concepts of semiconductor devices and electronic circuits.
• Solve basic binary operations and code conversion techniques using the logic gates.
• Explain the fundamentals of communication engineering.

UNIT I ELECTRICAL CIRCUITS AND MEASUREMENTS 12
Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Wattmeters and Energy meters.

UNIT II ELECTRICAL MACHINES 12

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12

UNIT IV DIGITAL ELECTRONICS 12

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12

TEXT BOOKS

REFERENCES
13A26  COMPUTER PROGRAMMING LABORATORY
(Common to all B.E. / B.Tech., Degree Programmes)

L T P C
0 1 2 2

COURSE OUTCOMES
Upon successful completion of this course, the students will be able to:

- Demonstrate how to use the UNIX Shell commands.
- Use the Shell programming constructs.
- Learn tracing mechanisms (for debugging), user variables, Shell variables, read-only variables, positional parameters, reading input to a Shell script.
- Test on numeric values, test on file type, and test on character strings using shell scripts.
- Write moderately complex Shell scripts and make them executable.

Execute programs written in C under UNIX environment.

LIST OF EXPERIMENTS

1. Study of UNIX OS, vi Editor.

2. Use of Basic UNIX Shell Commands:
   - ls, mkdir, rmdir, cd, cat, banner, touch, file, wc, sort, cut, grep, dd, dfspace, du, ulimit.

3. Shell Programming:
   - Interactive shell scripts
   - Positional parameters
   - Arithmetic Operators
   - if-then-fi, if-then-else-fi, nested if-else
   - Logical operators
   - if - elif, case structure
   - while, until, for loops, use of break
   - Metacharacters

4. Shell scripts for the following:
   - Showing the count of users logged in
   - Printing column wise list of files in your home directory
   - To count lines, words and characters in its input (do not use wc)

5. C Programming on UNIX:
   - Dynamic Storage Allocation
   - Pointers
   - Functions
   - File Handling

TOTAL: 45 PERIODS

SOFTWARE REQUIREMENTS
- UNIX/LINUX OS
- Gcc compiler
13A27  PHYSICS AND CHEMISTRY LABORATORY – II  
(Common to all B.E. / B.Tech., Degree Programmes)  

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PART A - PHYSICS LABORATORY – II

COURSE OUTCOMES
At the end of the Laboratory classes, the students
- demonstrate and report the elastic behaviour of materials
- demonstrate the interference property of light waves
- demonstrate the diffraction property of light waves
- measure the thermal properties of conducting materials
- identify the substance that deforms continuously when subjected to shearing stress.

LIST OF EXPERIMENTS
1. Determination of Young’s modulus – Uniform bending method.
2. Determination of Band Gap of a semiconductor material.
3. Determination of Hall Co-efficient.
5. Determination of wavelength of mercury spectrum using spectrometer and grating
7. Torsional pendulum – Determination of Moment of Inertia of the disc and Rigidity modulus of the material of the wire.

*A minimum of FIVE experiments shall be offered.*

PART B - CHEMISTRY LABORATORY – II

COURSE OUTCOMES
The student
- can estimate the amount of alkalinity and Dissolved Oxygen (DO) present in the water sample.
- gain knowledge in the estimation of copper in an alloy and iron in rust.
- quantify electrolyte and ion by measuring the conductance and emf.

LIST OF EXPERIMENTS
1. Estimation of copper in brass by EDTA method.
2. Determination of Dissolved Oxygen (DO) in water (Winkler’s method)
3. Estimation of alkalinity of Water sample
4. Estimation of Fe^{2+} ion in rust by Dichrometry
5. Conductometric titration (Mixture of acids vs NaOH)
6. Potentiometric Titration (Fe^{2+} vs K_{2}Cr_{2}O_{7})
7. Estimation of Fe^{3+} ion by spectrophotometry.

TOTAL: 45 PERIODS

*A minimum of FIVE experiments shall be offered.*

*Laboratory classes on alternate weeks for Physics and Chemistry.*
COURSE OUTCOMES

- An ability to use software for constructing curves, solids.
- An ability to create orthographic views and sectional view of the solids.
- An ability to create plan of residential building.
- An ability to draw isometric and pictorial views.

List of exercises using software capable of Drafting and Modeling

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola involutes using Bspline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

TOTAL: 45 PERIODS

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

List of Equipments for a batch of 30 students

1. Pentium IV computer or better hardware with suitable graphics facility – 30 Nos.
2. Licensed software for Drafting and Modeling – 30 Licenses
3. Laser Printer or Plotter to print / plot drawings – 2 Nos.
13A29 ENGLISH LANGUAGE SKILL LABORATORY
(Common to all B.E. / B.Tech., Degree Programmes)

COURSE OUTCOMES
The Student will
• improve their pronunciation skill.
• gather information from any speech.
• imbibe the stress and intonation of the native speakers’ accent.

1. Micro Skills
   - Spotting the Homonyms / Silent letter words / mispronounced words
   - Identifying the missing words in native speech
   - Finding the cluster words
   - Marking correct punctuation
   - Marking word chunks
   - Identification of sentences

2. Content Comprehension and making inferences
   - Listening to audio files of Speech, Poetry, Recent Issues, News clippings, etc
     a. True / False
     b. Multiple Choice Questions
     c. Filling the blanks
     d. Filling the charts

3. Listen and Act
   - Drawing the map using audio
   - Picture completing task
   - Transferring data to Graph

4. Interpreting the video clippings

5. Listening to Conversations

TOTAL: 30 PERIODS
13ME31     FOURIER TRANSFORMS AND COMPLEX ANALYSIS     L T P C
                   3 1 0 4

COURSE OUTCOMES
On the successful completion of the course, the student should be able to,
•   Perform Fourier series analysis of the functions.
•   Implement the properties of Fourier transforms and Compute the Fourier transforms of various
    functions.
•   Calculate the Fourier series solution of Wave and Heat equations.
•   Grasp analytic functions and their properties and be introduced to the host of conformal mappings
    with suitable examples that have direct applications.
•   Understand the basics of complex integration and the concept of contour integration encountered
    in practice.

UNIT I     FOURIER SERIES
Dirichlet’s conditions – General Fourier series – Odd and even functions – Half range Sine series – Half
range Cosine series – Complex form of Fourier series – Parseval’s identity – Harmonic analysis.

UNIT II     FOURIER TRANSFORMS
Fourier Integral theorem (without proof) – Fourier transform pair – Fourier Sine and Cosine transforms –

UNIT III     APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS
Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state
solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series
solutions in Cartesian coordinates.

UNIT IV     ANALYTIC FUNCTIONS
Functions of a complex variable – Analytic functions – Necessary and Sufficient conditions (excluding
proofs) – Harmonic and orthogonal properties of analytic functions – Harmonic conjugate – Construction
of analytic functions – Conformal mapping: w: z+c, cz, 1/z and bilinear transformation.

UNIT V     COMPLEX INTEGRATION
Complex integration – Statement and applications of Cauchy’s integral theorem and Cauchy’s integral
formula (excluding proofs) – Taylor’s and Laurent’s expansions – Singular points – Residues – Residue
theorem (excluding proof) – Application of residue theorem to evaluate real integrals – Unit circle and
semi-circular contour (excluding poles on boundaries).

    L: 45, T: 15, TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES
   Delhi, 2007.
13ME32 ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to all B.E./B.Tech. Degree Programmes) L T P C 3 0 0 3

COURSE OUTCOMES
Upon successful completion of course the student will be able to
- Understand the various ecosystem and biodiversity
- Classify the different types of natural resources and identify the role of individual in conservation of resources
- Identify and analyse the causes, effects and control measures of environmental pollution
- Identify the different types of environmental hazards and their management
- Analyse the social issues related to the environment and how human population affect the environment

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9
Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers– energy flow in the ecosystem – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) aquatic (pond) ecosystems. Field study of simple ecosystems –pond and forest. Introduction to biodiversity: definition - genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values –India as a mega-diversity nation – hot spots of biodiversity –threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation. Field study of common plants, insects, birds.

UNIT II NATURAL RESOURCES 9
Forest resources: Use and over-exploitation, deforestation, case studies- dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide Problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, case studies – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT III ENVIRONMENTAL POLLUTION 9
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Noise pollution (e) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – e-Waste: Definition-dimension of the problem - source-toxic Substances in e-waste - risks related to toxic substances–environmental problems-role of an individual in prevention of pollution.

UNIT IV ENVIRONMENTAL HAZARDS 9
Environmental hazards: Definition – Hazard- Types-Natural and man-made hazards – Natural hazards: Causes, effect and management of Earthquake, Flood, Landslide, Cyclones and Tsunami; Man-made Hazards: Hazards due to dams and reservoirs, hazards due to nuclear power plant, Industrial hazards. Case study: Chernobyl disaster, Bhopal gas tragedy.

UNIT V SOCIAL ISSUES, HUMAN POPULATION AND THE ENVIRONMENT 9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES
On successful completion of this course, the student will be able to

• State and illustrate the first and second laws of thermodynamics.
• Identify and explain the concepts of entropy, enthalpy, specific energy, reversibility, and irreversibility.
• Apply the first and second laws of thermodynamics to formulate and solve engineering problems for (i) closed systems, (ii) open systems under steady state and transient conditions and (iii) power cycles.
• Use thermodynamic tables, charts, and relations to obtain appropriate property data to solve thermodynamics problems.

UNIT I  BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS  12
Continuum - microscopic and macroscopic approach - thermodynamic system (closed and open system) - thermodynamic properties and equilibrium.
Point and Path functions - different modes of work - concept of temperature – heat - First law applied to systems and control volumes - steady and unsteady flow analysis.

UNIT II  SECOND LAW OF THERMODYNAMICS  12
Kelvin-Planck and Clausius statements - reversible and irreversible processes - Carnot theorems - thermodynamic temperature scale, Clausius inequality and concept of entropy, principle of increase of entropy; availability and irreversibility.

UNIT III  PROPERTIES OF PURE SUBSTANCES  12
Thermodynamic properties of pure substances in solid, liquid and vapour phases - phase-change processes of pure substances - thermodynamic property tables and charts for steam - use of compressibility chart.

UNIT IV  THERMODYNAMIC CYCLES  12

UNIT V  PSYCHROMETRY  12

TEXT BOOK

REFERENCES
http://nptel.ac.in/video.php?subjectId=112105123
13ME34                MECHANICS OF MATERIALS              L T P C
                                   3 1 0 4

COURSE OUTCOMES
On successful completion of this course, the student will be able to

- Understand and design simple load carrying members subjected to an axial, shear and thermal loading.
- Understand stress tensor and to analyze Bi-axial stresses using Mohr’s circle.
- Assess stresses and deformations in beams and columns subjected to different loadings.
- Analyze and design springs, thin pressure vessels and shafts subjected to simple loadings.
- Design simple load carrying elements for engineering applications.

UNIT I    STRESS STRAIN DEFORMATION OF SOLIDS       12

UNIT II    ANALYSIS OF STRESSES IN TWO DIMENSIONS    12
Stress tensor, Bi-axial stresses at a point – Stresses on inclined plane, Principal planes and stresses, Mohr’s circle for biaxial stresses – Maximum shear stress. Evaluation of hoop stress and longitudinal stress in thin cylindrical and spherical shells.

UNIT III   BEAMS                                12
Shear force and Bending Moment diagrams for Cantilever, Simply supported and Overhanging beams under point load and UDL. Theory of simple bending and assumptions. Section Modulus – Flitched beams.

UNIT IV    DEFLECTION OF BEAMS AND COLUMNS      12

UNIT V    TORSION                              12

L: 45    T: 15    TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES
13ME35 MANUFACTURING TECHNOLOGY – I  

COURSE OUTCOMES:

Upon successful completion of this course, the student will be able to:

- Gain the knowledge about the various methods of casting and specific products fabrication
- Get the ability to identify and select respective metal joining process for the on hand task.
- Get aware on the metal forming methods and the respective machineries which are involved on those processes
- Gain knowledge on the process of sheet metal processing and its commercial applications
- Get aware on the polymer processing for various industrial and domestic applications.

UNIT I METAL CASTING PROCESSES  

UNIT II JOINING PROCESSES  

UNIT III BULK DEFORMATION PROCESSES  

UNIT IV SHEET METAL PROCESSES  

UNIT V MANUFACTURING OF PLASTIC COMPONENTS  

TOTAL: 45 PERIODS

TEXT BOOKS
REFERENCES

13ME36 ELECTRICAL DRIVES AND CONTROLS

COURSE OUTCOMES
On Successful completion of the course, the students will be able to
- Describe the concept of basic concepts of different types of electrical machines and their performance.
- Discuss the construction, working principle, characteristics and applications of single phase and three phase induction motor.
- Illustrate the various types of D.C. motor starters.
- Identify the importance of speed control of D.C. series and shunt motors.
- Discriminate the various methods of speed control of A.C. Drives.

UNIT I INTRODUCTION 12
Basic Elements – Types of Electric Drives – factors influence the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and load variation factors.

UNIT II DRIVE MOTOR CHARACTERISTICS 12
Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

UNIT III STARTING METHODS 12
Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES 12
Speed control of D.C series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers – applications.

UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES 12
Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES
13ME37 MATERIALS TESTING LABORATORY L T P C
0 0 3 2

COURSE OUTCOMES
On Successful completion of the course, the students will be able to
- Evaluate elastic constants experimentally for different materials subjected to direct, shear and bending
- Enumerate hardness and impact resistance of the materials before and after heat treatment
- Analyze, strength and stiffness of helical coil springs
- Examine the materials for engineering applications.

LIST OF EXPERIMENTS
1. Tension test on a mild steel rod
2. Single shear and Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen: Charpy and Izod Test
5. Hardness test - Brinnell, Rockwell and Vickers Hardness Test.
6. Deflection test on Timber beams
7. Test on open coil and closed coil springs
8. Effect of hardening- Improvement in hardness and impact resistance of steels.
9. Tempering- Improvement Mechanical properties Comparison
   (i) Unhardened specimen
   (ii) Water quenched Specimen

LIST OF EQUIPMENTS (for a batch of 30 students)
1. Universal Tensile Testing machine – 1 No
2. Shear attachment – 1 No
3. Torsion Testing Machine – 1 No
4. Impact Testing Machine – 1 No
5. Brinell hardness Testing Machine – 1 No
6. Rockwell Hardness Testing Machine 1 No
7. Vickers hardness Testing Machine – 1 No
8. Spring Testing Machine for tensile and compressive loads – 1 No
9. Muffle Furnace – 1 No

TOTAL: 45 PERIODS
13ME38  ELECTRICAL ENGINEERING LABORATORY  

COURSE OUTCOMES  
On Successful completion of the course, the students will be able to  
• Describe the load characteristics of different DC machines  
• Analyze the characteristics of AC rotating machines  
• Illustrate the various types of starters for DC and AC machines  
• Describe the characteristics of transformer  
• Demonstrate the speed control practices associated with DC and AC machines  

LIST OF EXPERIMENTS  
1. Load test on DC Shunt & DC Series motor  
2. O.C.C & Load Characteristics of DC Shunt and DC Series generator  
3. Speed control of DC shunt motor (Armature, Field control)  
4. Load test on single phase transformer  
5. O.C & S.C Test on a single phase transformer  
6. Regulation of an alternator by EMF & MMF methods  
7. V curves and inverted V curves of synchronous Motor  
8. Load test on three phase squirrel cage Induction motor  
9. Speed control of three phase slip ring Induction Motor  
10. Load test on single phase Induction Motor  
11. Study of DC & AC Starters  

TOTAL: 45 PERIODS
13ME39 COMMUNICATION SKILLS AND TECHNICAL SEMINAR (Common to all B.E./B.Tech. Degree Programmes) L T P C 0 0 3 2

COURSE OUTCOMES
On Successful completion of the course, the students will be able to
- Express themselves fluently and appropriately in social and professional contexts.
- Develop the sub-skills required for paper presentations and group discussions.
- Acquire the soft skills and interpersonal skills which will help them to excel in their workplace.

A) LANGUAGE FUNCTIONS (15 hrs)
1. Compare and contrast
2. Giving reasons
3. Reporting
4. Expressing agreement and disagreement
5. Evaluating different standpoints
6. Analyzing a problem and giving solution.
7. Describing daily routines, events, and weather
8. Describing Objects
9. Defending a point of view
10. Talking about future plans and intentions

Language Functions:
The teacher should build micro activities to develop the use of language required to handle these Sub-functions of communication. In the process, the learners should get used to the linguistic Elements needed for these functions.

B) SPEECH PRACTICE (15 hrs)
The themes are:
1. Cloning
2. Artificial satellites
3. Renewable sources
4. Telecommunication
5. Cyber Revolution
6. Space research
7. Polythene pollution
8. Fossil fuels
10. Ecological threats
11. Water resources
12. Nuclear technology
13. Scientific farming
14. Thermal power plants
15. Nano Technology
16. Robotics
17. Artificial intelligence
18. Role of Fibre Optics
19. Exploration of Mars
20. Gas turbines
21. Indian space missions
22. Converting agricultural wastes for useful purposes
23. Developments in transportation
24. Scientific Farming
25. Impact of global warming
26. Desalination of water
27. Technology for national security
28. Industrial development and ecological issues
29. Recent trends in Automobiles
30. Hazards of E-waste
31. Mobile Jammer
32. Touch Screen Technology
33. Tidal Power
34. 3G Technology
35. Tsunami Warning System
36. Blue Tooth Technology

Seminar presentation on the themes allotted:
Each student should collect materials from Books, Internet, Journals and Newspapers for his/her theme and prepare a short Seminar Paper for 4 to 5 Pages. The presentation should be for 10 minutes using power point frames. It should be followed by a Viva Voce during which others should come forward to question, clarify, supplement or evaluate.

C) GROUP DISCUSSION / DEBATE (10hrs)
Grouping (each group consisting of 12 members)
Topics (12 topics – 3 topics to be selected by each group - to be practiced in cycles)

Group Discussion / Debate Topics:
1. Advertising is a legalized form of lying- Discuss.
2. Communicative competency in English is the golden key for success in the Global arena.
3. Is it just to force people to retire?
4. Attitude decides one’s altitude in life.
5. Should an aspiring student go for a course which is in demand or for a course which he/she likes?
6. Is westernization a cultural degradation or enrichment?
7. Is Brain drain a threat to India?
9. Do Mobile phones spoil the youth?
10. No two generations see eye to eye- Discuss.
11. Is scientific advancement a boon or a bane?
12. Does ragging develop friendship?

D) SPEAKING ON THE GIVEN PICTURE/DIAGRAM/CHART/TABLE (5 hrs)
RECORD LAY OUT:
Every student has to maintain a record in which he/she has to incorporate the following details.
• First page containing learner details and the topic of specialization
• Use of appropriate Language used in Language Function should be listed.
• Three newspaper cuttings or journal or internet sources related to the specialized theme. (To be pasted on the pages)
• 10 Quiz questions of the specialized topic with expected answers.
• The seminar paper presented by the learner (to be pasted).
• Notes of observation - Lab. (Details about Interview skills – GD – Soft skills)
• The record should be duly signed by the course teacher and submitted to the External Examiner for verification during the semester practical.

REFERENCES
13ME41 PROBABILITY, STATISTICS AND NUMERICAL METHODS  L  T  P  C
3 1 0 4

COURSE OUTCOMES
On Successful completion of the course, the students will be able to
• Understand the concepts of probability, random variables and their distributions.
• Apply the concepts of estimation (confidence intervals) and hypothesis testing for population averages and percentages.
• Analyze the appropriate tabular for displaying design of experiments.
• Use numerical techniques for solving linear system of equations and numerical integration problems.
• Demonstrate the utility of numerical techniques of ordinary differential equations.

UNIT I ONE DIMENSIONAL RANDOM VARIABLES AND ITS DISTRIBUTIONS 12
Discrete and continuous random variables –Moments, Moment generating functions and their properties - Discrete distributions: Binomial and Poisson – Continuous distribution: Normal distribution.

UNIT II TESTING OF HYPOTHESIS 12
Sampling distributions - Tests for single mean, Proportion, Difference of means (for large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.

UNIT III DESIGN OF EXPERIMENTS 12
Completely randomized design – Randomized block design – Latin square design.

UNIT IV SOLUTION OF EQUATIONS AND NUMERICAL INTEGRATION 12

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES
13ME42 FLUID MECHANICS AND MACHINERY

COURSE OUTCOMES:
On Successful completion of the course, the students will be able to

- Use Euler’s and Bernoulli’s equations and the conservation of mass to determine velocities, pressures, and accelerations for incompressible fluids.
- Determine flow rates, pressure changes, minor and major head losses for viscous flows through pipes, ducts.
- Apply dimensional analysis techniques in fluid mechanics problems.
- Evaluate the performance of axial and radial turbines.
- Evaluate the operation and performance of centrifugal and reciprocating pumps.

UNIT I INTRODUCTION 12
Units and Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation. Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube

UNIT II FLOW THROUGH CIRCULAR CONDUITS 12

UNIT III DIMENSIONAL ANALYSIS 10
Dimension and units: Buckingham’s ІІ theorem. Discussion on dimensionless parameters. Models and similitude - Applications of dimensionless parameters.

UNIT IV HYDRAULIC TURBINES 13

UNIT V HYDRAULIC PUMPS 13
Pumps: definition and classifications - Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principles, indicator diagram and work saved by air vessels and performance curves - cavitations in pumps - rotary pumps: working principles of gear and vane pumps.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES
13ME43 KINEMATICS OF MACHINERY

L T P C
3 1 0 4

COURSE OUTCOMES
On Successful completion of the course, the students will be able to
- Understand the concept of machines, mechanisms and related terminologies.
- Analyse a mechanism for displacement, velocity and acceleration at any point in a moving link
- Understand the role of friction in drives and brakes.
- Understand the theory of gears, gear trains and cams

UNIT I BASICS OF MECHANISMS
Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine - Degree of Freedom – Mobility - Kutzbach criterion (Gruebler’s equation) - Grashoff’s law- Kinematic Inversions of four-bar chain and slider crank chain - Mechanical Advantage- Transmission angle.
Description of common Mechanisms - Offset slider mechanism as quick return mechanisms, Pantograph, Straight line generators (Peaucellier and Watt mechanisms), Steering gear for automobile.

UNIT II KINEMATIC ANALYSIS
Displacement, velocity and acceleration analysis of simple mechanisms (Single slider crank mechanism and four bar mechanism) - Graphical Methods for relative velocity and acceleration polygons - Coincident points – Coriolis acceleration - Approximate analytical expression for displacement, velocity and acceleration of piston of reciprocating engine mechanism.

UNIT III FRICTION DRIVES
Belt and rope drive – Open and cross belt drive – Belt materials – Creep and slip - Ratio of tensions – Effect of centrifugal force – condition for maximum power – Friction in Journal Bearing - Flat pivot bearing - Friction clutches – Single plate –Multi plate - Brakes - Shoe brake and Internal Expanding brake only.

UNIT IV KINEMATICS OF CAMS
Types of cams and followers - Displacement diagrams - Parabolic, Simple harmonic and uniform acceleration and retardation motions - Graphical construction of displacement diagrams and layout of plate cam profiles for reciprocating and oscillating motions with Knife-edge, roller and flat- faced followers - circular arc and tangent cams - Pressure angle and undercutting.

UNIT V GEARS
Types - Spur gear terminology and definitions – Pressure angle and undercutting - Law of gearing – Length of path of contact and contact ratio - Gear profiles (involute and cycloid) – Interference and undercutting – Minimum number of teeth to avoid interference - Gear trains – Simple, compound and Epicyclic gear trains - Differentials.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS
REFERENCES

BIS Codes of Practice/Useful Websites
1. IS 2458 : 2001, Vocabulary of Gear Terms – Definitions Related to Geometry
COURSE OUTCOMES

On successful completion of the course, the students will be able to

- Gain the basic knowledge about the metal removal process and respective industrial standards
- Gain the knowledge about the centre lathe, its accessories and relative operations which are performed in machine shop.
- Aware on the constructional features and operating methods of various special purpose machine tools
- Gain knowledge on surface machining processes, design and fabrication of important machine elements
- Gain knowledge on CNC machining, respective equipment and its parts also will get ability to develop CNC programs for machining of materials

UNIT I  THEORY OF METAL CUTTING  10

UNIT II  CENTRE LATHE AND SPECIAL PURPOSE LATHES  14
Centre lathe, constructional features, various operations, taper turning and thread cutting methods, machining time and power estimation. Capstan and turret lathes – Turret Indexing mechanism, bar feeding mechanism. Single spindle automatic lathes - Introduction to copying systems and transfer machines.

UNIT III  SPECIAL MACHINE TOOLS  12

UNIT IV  ABRASIVE PROCESSES AND GEAR CUTTING  12

UNIT V  CNC MACHINE TOOLS AND PART PROGRAMMING  12

L: 53  T: 07  TOTAL: 60 PERIODS

TEXT BOOKS

REFERENCES
13ME45 ENGINEERING MATERIALS AND METALLURGY  L T P C
3 0 0 3

COURSE OUTCOMES
On Successful completion of the course, the students will be able to
- Attain the knowledge on structure and properties of materials.
- Attain skill to use phase diagrams and know presence of various phases with the addition of alloying elements.
- Attain the capability to test various properties of materials. Also obtain knowledge to select appropriate materials for different applications and environmental conditions.
- Obtain knowledge on different heat-treatment procedures for various materials.
- Acquire knowledge about plastics, ceramics and composites which are replacing metallic materials in several machineries.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

UNIT II MECHANICAL PROPERTIES AND TESTING 9

UNIT III HEAT TREATMENT 9

UNIT IV FERROUS AND NON FERROUS METALS 9

UNIT V NON-METALLIC MATERIALS 9

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
13ME46 ELECTRONICS AND MICROPROCESSOR L T P C 3 0 0 3

COURSE OUTCOMES
On Successful completion of the course, the students will be able to
• Summarize the fundamental concepts of Rectifier & Power Supply Circuits
• Acquire knowledge about transistor biasing, amplifiers and negative feedback concepts
• Demonstrate Boolean functions using K-map, counter using flip flop
• Generalize the Architecture of 8085 Microprocessors
• Illustrate the concept of Assembly language and interfacing programs

UNIT I RECTIFIERS AND POWER SUPPLY CIRCUITS 9
Half wave and Full wave rectifier analysis - Inductor filter – Capacitor filter – Series voltage regulator –
Switched mode power supply

UNIT II TRANSISTORS AND AMPLIFIERS 9
Bipolar junction transistor- CB, CE, CC configuration and characteristics-Biasing circuits - Class A,B and
C amplifiers - Configuration and characteristic of FET and SCR - Concept of Negative feedback- Voltage /
current, series/shunt feedback

UNIT III DIGITAL ELECTRONICS 12
Basic digital circuits AND - OR - NAND - NOR - EX-OR - EX-NOR operations- Representation and
simplification of logic functions using K Map - Four variable -Don’t care conditions - Flip-flops - SR, JK, D, T, and Master-Slave JK – Characteristic table and equation , Realization of one flip flop using other
flip flops Asynchronous and Synchronous Up/Down counter

UNIT IV 8085 MICROPROCESSOR 9
Block diagram of microcomputer-Architecture of 8085 - Pin configuration - Instruction set-Addressing
modes - Simple programs using arithmetic and logical operations

UNIT V INTERFACING AND APPLICATIONS OF MICROPROCESSOR 6
Basic interfacing concepts - Interfacing of Input and Output devices - Applications of microprocessor
Temperature control, Stepper motor control and Traffic light control

TOTAL: 45 PERIODS

TEXT BOOKS
   Education, 8th printing, 2008.
3. Ramesh Goankar, “Microprocessor Architecture Programming and Applications with 8085”, 5th

REFERENCES
COURSE OUTCOMES
On Successful completion of the course, the students will be able to
• Apply Bernoulli’s equations in flow experiments to determine the coefficient of discharge.
• Determine flow rates, pressure changes, and minor and major head losses for viscous flows through pipes.
• Evaluate the performance of turbines.
• Evaluate the operation and performance of different types of pumps

LIST OF EXPERIMENTS
1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rotameter.
4. Determination of losses in pipes.
5. Conducting experiments and drawing the characteristic curves of single and multi stage Centrifugal pump.
6. Conducting experiments and drawing the characteristic curves of Reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel turbine.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.
11. Study on Bernoulli’s theorem apparatus.

LIST OF EQUIPMENTS
1. Orifice meter setup
2. Venturi meter setup
3. Rotameter setup
4. Pipe Flow analysis setup
5. Centrifugal pump/submergible pump setup
6. Reciprocating pump setup
7. Gear pump setup
8. Pelton wheel setup
9. Francis turbine setup
10. Kaplan turbine setup
11. Bernoulli’s theorem apparatus

Quantity: One each.

TOTAL: 45 PERIODS
13ME48 MANUFACTURING TECHNOLOGY LABORATORY

COURSE OUTCOMES

On Successful completion of the course, the students will be able to

- Gain hands on experience on working of general purpose machine tools and on various manufacturing processes.
- Gain practical hand on exposure to students in the various metal cutting operations using commonly used machine tools.
  (Atleast minimum of 2 exercises in each section and put together 12 exercises)

UNIT I LATHE
1.1. Facing, plain turning and step turning.
1.2. Taper turning using compound rest, Tailstock set over, etc.
1.3. Single and Multi-start V thread, cutting and knurling.
1.4. Boring and internal thread cutting.

UNIT II WELDING AND SHEET METAL WORK EXCERCISES
2.1. Horizontal, Vertical and overhead welding.
2.2. Gas Cutting, Gas Welding.
2.3. Fabrication of sheet metal tray/ funnel.

UNIT III PREPARATION OF SAND MOULD
3.1. Mould with solid, split patterns.
3.2. Mould with loose-piece pattern.

UNIT IV SPECIAL MACHINES PART - I
4.1. Two or More Measurements in Metal Cutting Experiment (Example: Shear Angle, Cutting Force, Tool Wear etc.)
4.2. One or More Exercises in Shaper, Slotter, Planner, Drilling, Milling Machines (Example: Round to Square, Dovetail in shaper, Internal keyway cutting in Slotter, Round to square in Planner, Drilling, reaming and tapping in Drilling machine, Gear Milling and Keyway milling in Milling machine.)
4.3. Two or More Exercises in Grinding / Abrasive machining (Example: Surface Grinding, cylindrical Grinding.)

UNIT V SPECIAL MACHINES PART - II
5.1. Two or More Exercises in Assembly of Machined Components for different fits. (Example: Parts machined using Lathes, Shapers, Drilling, Milling, and Grinding Machines etc.)
5.2. One or More Exercises in Capstan or Turret Lathes.
5.3. One or More Exercises in Gear Machining (Example: Gear Milling, Gear Hobbing etc.)

TOTAL: 45 PERIODS

LIST OF EQUIPMENTS
1. Centre Lathe with accessories 15

2. Welding
   2.1 Arc welding machine 04
   2.2 Gas welding machine 01
   2.3 Brazing machine 01
3. Sheet Metal Work facility
   3.1 Hand Shear 300mm   01
   3.2 Bench vice        05
   3.3 Standard tools and calipers for sheet metal work 05

4. Sand moulding Facility
   4.1 Moulding Table    05
   4.2 Moulding boxes, tools and patterns 05

5. Plastic Moulding
   5.1 Injection Moulding Machine 01

6. Special Machines Part I and II
   6.1. Turret and Capstan Lathes 01
   6.2. Horizontal Milling Machine 01
   6.3. Vertical Milling Machine 01
   6.4. Surface Grinding Machine 01
   6.5. Cylindrical Grinding Machine 01
   6.6. Shaper 02
   6.7. Slotter 01
   6.8. Planner 01
   6.9. Radial Drilling Machine 01
   6.10. Tool Dynamometer 01
   6.11. Gear Hobbing Machine 01
   6.12. Tool Makers Microscope 01
13ME51 THERMAL ENGINEERING

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Explain the concept of turbo machinery systems.
CO2: Identify and explain the various parts of IC engines and also compute the performance of the IC engine and the effect of emission on environment.
CO3: Estimate the performance of steam turbines and explain the basic concept of boilers.
CO4: Express the working Principle of reciprocating compressors and also study its performance.
CO5: Evaluate the performance of Refrigeration and explain the basics of Air conditioning systems.

UNIT I BASIC TURBO SYSTEMS

UNIT II INTERNAL COMBUSTION ENGINES

UNIT III STEAM TURBINES AND BOILERS

UNIT IV RECIPROCATING AIR COMPRESSORS
Reciprocating Compressor - Classification and working principle, work of compression with and without clearance - Multistage air compressor and inter cooling - Performance calculation.

UNIT V REFRIGERATION AND AIR CONDITIONING
Refrigeration system - VCR cycle – Performance calculations - working principle of Vapour Absorption system–Green refrigerants - Special refrigeration application; Air Conditioning: Types – Factors affecting comfort in air conditioning – Process Air conditioning.

TEXT BOOKS

REFERENCES
4. http://nptel.ac.in/courses/112105128/11
COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: Apply stress analysis theory, fatigue theory and appropriate criteria of failure to the design of simple machine elements

CO2: Design a shaft for any specific application with appropriate selection of keys and coupling

CO3: Solve problems on joints under different loading condition.

CO4: Select and design suitable energy storing devices for any given application.

CO5: Choose proper bearing for specific application

UNIT I STEADY AND VARIABLE STRESSES IN MACHINE MEMBERS

STRESS ANALYSIS: Types of stresses, mechanical properties of materials, static stress equation in axial, bending and torsional loading, theories of failure, factor of safety. COMBINED STRESSES: Combination of normal stresses, eccentric loading of members, combination of normal and shear stresses, principal stresses.


UNIT II DESIGN OF SHAFTS AND COUPLINGS

DESIGN OF SHAFTS AND COUPLINGS: Design of shafts and rods for fatigue loading based on Soderberg, Goodman and Gerber equations, Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength and critical speed. Design of square keys- Couplings-types and applications, use of standards, design and selection of rigid couplings, flexible flange couplings.

UNIT III DESIGN OF FASTNERS AND WELDED JOINTS


UNIT IV DESIGN OF SPRINGS

Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs - Belleville springs.

UNIT V DESIGN OF BEARINGS

SLIDING CONTACT BEARINGS: Theory of lubrication, hydrodynamic bearings, Sommerfeld number, design of hydrodynamic bearings.

ROLLING CONTACT BEARINGS: Static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove and angular contact ball bearings

Note: (Use of P S G Design Data Book is permitted in the University examination)

TEXT BOOKS

REFERENCES

STANDARDS
13ME53 DYNAMICS OF MACHINERY

L T P C
3 1 0 4

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: solve problems on dynamic forces and torques in reciprocating engines.
CO2: compute the unbalanced forces in single and multi-cylinder engines
CO3: calculate the natural frequency of simple vibratory system.
CO4: determine the amplitude of the forced vibration caused by various means.
CO5: Identify suitable governor for a particular application and describe the basic concepts in gyroscope

UNIT I FORCE ANALYSIS AND FLYWHEEL 12

UNIT II BALANCING 12

UNIT III FREE VIBRATION 12
Basic features of vibratory systems - Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - natural frequency - Transverse loads, vibrations of beams with concentrated and distributed loads - Dunkerly’s method. Types of Damping - Damped free vibration – logarithmic decrement - Whirling of shafts and critical speed - Torsional systems; Natural frequency of two and three rotor systems.

UNIT IV FORCED VIBRATION 12

UNIT V GOVERNORS and PRECESSION 12

L:45; T:15; TOTAL:60 PERIODS

TEXT BOOKS

REFERENCES
13ME54 COMPUTER AIDED DESIGN AND MANUFACTURING  

**COURSE OUTCOMES**

Upon completion of this course, the students will be able to

- **CO1**: Explain the basic concept of 2D and 3D CAD graphical manipulations.
- **CO2**: Explain basic concept of various solid modeling techniques
- **CO3**: Write simple 2D CNC Programming with Subroutines through Manual Part Programming
- **CO4**: Write simple APT programs using subroutines concepts.
- **CO5**: Describe the working principles of various rapid prototyping systems.

**UNIT I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS**  
Introduction of CAD Tools, input, Output primitives. 2-D & 3-D transformation (Translation, scaling, rotation), windowing, view ports, clipping, transformation.

**UNIT II SOLID MODELING**  

**UNIT III MANUAL PART PROGRAMMING**  
Basic components of an NC system, NC motion control, interpolation, part programming formats, manual part programming, NC coding systems (ISO and EIA)-NC words, macro statements, coordinate system, structure of a part program, G & M codes, tool length compensation, cutter radius and tool nose radius compensation, do-loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre. Writing simple 2D manual part programming.

**UNIT IV COMPUTER AIDED PART PROGRAMMING**  
APT programming: APT language structure, APT geometry: definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to-point motion commands, continuous path motion commands. Post processor commands, complication control commands. Macro-subroutines, part program preparation for typical examples.

**UNIT V INTRODUCTION TO RAPID PROTOTYPING SYSTEMS**  


**TOTAL: 45 PERIODS**

**TEXT BOOKS**


**REFERENCES**

4. CAD/CAM by Groover and Zimmers,
13ME55 PROFESSIONAL ETHICS AND HUMAN VALUES

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: recognize the core values that shape the ethical behavior of an engineer
CO2: expose awareness on professional ethics and human values.
CO3: distinguish their role in technological development

UNIT I HUMAN VALUES

UNIT II ENGINEERING ETHICS

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION
Engineering as experimentation - engineers as responsible experimenters - codes of ethics - a balanced outlook on law - the challenger case study

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS

UNIT V GLOBAL ISSUES
Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -Moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India, etc.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Analyze the characteristics of measuring instruments.
CO2: Demonstrate the working of pressure, flow, vibration and temperature measuring instruments.
CO3: Explain the working of sensors.
CO4: Recognize the basic principle of control systems.
CO5: Discuss the importance of mechanical and electrical system.

UNIT I  CONCEPT OF MEASUREMENT  9
General concept – Generalized measurement system-Units and standards-measuring instruments- sensitivity, readability, range of accuracy, precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration, interchangeability. Selection of measuring instruments-limits, fits and tolerances-Tolerance grads and allocation of tolerance

UNIT II PRESSURE AND FLOW MEASUREMENT  9
Manometer, elastic transducer, elastic diaphragm transducer – pressure cell, bulk modulus pressure gauge – Mc Leod gauge – thermal conductivity gauge, calibration of pressure gauge, flow measurement – turbine type meter, hotwire anemometer, magnetic flow meter; liquid level sensors, light sensors, selection of sensors.

UNIT III VIBRATION AND TEMPERATURE  9
Elementary accelerometer and vibrometer – seismic instrument for acceleration – velocity measurement, piezo electric accelerometer, temperature measurement-liquid in glass thermometer, pressure thermometer, resistance temperature detector, thermocouples and thermopiles, thermistor, total radiation pyrometer, optical pyrometer – temperature measuring problem in flowing fluid.

UNIT IV TRANSDUCER VARIABLES AND MEASUREMENT SIGNALS  9
Three stages of generalized measurement system – mechanical loading – static characteristics of instruments- factors considered in selection of instruments – commonly used terms, error analysis and classification – sources of error – frequency response – displacement transducers – potentiometer, strain gauge – orientationof strain gauge, LVDT – variable reluctance transducers, proximity sensors, capacitance transducers, tacho generator; smartsensors, integrated sensors, radio telemetry, torque measurements, precision systems like video discs and drives, laser printer etc.,

UNIT V CONTROL SYSTEM PRINCIPLE  9
Basic elements of control systems – open loop and closed loop control – elements of closed loop control system – introduction to sampled data, digital control and multivariable control systems. Elements of lead and lag compensation, elements of proportional, integral - derivative (PID) control.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
13ME57 COMPUTER AIDED DESIGN AND MANUFACTURING LABORATORY L T P C
0 0 3 2

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Develop Part modeling, Assembly and detailing of practical engineering components.
CO2: Apply the concept of Geometric dimensioning and tolerance to create manufacturing drawing with bill of materials.
CO3: Develop a Part model of existing physical component with aid of manual measuring instruments.
CO4: Develop a virtual product for the new concepts/ideas.
CO5: Generate CL data using CAM software
CO6: Perform simple operations in CNC Lathe and Milling machines

LIST OF EXERCISES

COMPUTER AIDED DESIGN LABORATORY

PART A - 2D to 3D Conversion
1. Part modeling, Assembly and Detailing of Screw Jack
2. Part modeling, Assembly and Detailing of Flange Coupling
3. Part modeling, Assembly and Detailing of Knuckle Joint
4. Part modeling, Assembly and Detailing of Plummer Block

PART B – Reverse Engineering
1. 3D Modeling of given physical components – Connecting Rod
2. 3D Modeling of given physical components – Spur Gear
3. 3D Modeling of given physical components – Piston

PART C – New Product Development
1. Develop a new product for given concept /ideas - I
2. Develop a new product for given concept /ideas - II

COMPUTER AIDED MANUFACTURING LABORATORY

Numerical Control (NC) code generation using CAM software’s for the following milling and Turning operations.
1. Facing
2. Curve following
3. Pocket milling
4. Drilling
5. Step Turning
6. Taper turning.

TOTAL: 45 PERIODS
13ME58 THERMAL ENGINEERING LABORATORY  

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: Examine the properties of oil using various apparatus.
CO2: Evaluate and identify the optimum load which gives maximum efficiency in IC engines.
CO3: Demonstrate the calculation of Indicated power and frictional power by Morse method and retardation method in IC engines respectively.
CO4: Design & Conduct experiments on ICE to investigate & compare the performances.
CO5: Characterize different type of Oil/Fuels.

Course Content: (Minimum 12 experiments to be conducted)
- Study of Energy Balance and Mass Balance in Engines
- Characterization of Oil/Fuel

LIST OF EQUIPMENTS (for a batch of 30 students)
1. I.C Engine – 2 stroke and 4 stroke model 1 set
2. Red Wood Viscometer 1 No.
3. Apparatus for Flash and Fire Point 1 No.
4. Four stroke Diesel Engine with mechanical loading. 1 No.
5. Four stroke Diesel Engine with hydraulic loading. 1 No.
6. Four stroke Diesel Engine with electrical loading. 1 No.
7. Multi-cylinder Petrol Engine 1 No.
9. Data Acquisition system with any one of the above engines 1 No.
10. Saybolt Viscometer 1 No.

TOTAL: 45 PERIODS
13ME61  HEAT AND MASS TRANSFER  L T P C
3 1 0 4

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Apply the concept of one dimensional steady and transient heat conduction through various coordinates systems.
CO2: Manipulate the concept of convection with the flow of fluids in different elements.
CO3: Identify the basic laws and applications of phase change heat transfer.
CO4: Apply the concept of radiation to solve problems in heat transfer system.
CO5: Illustrate the concept of diffusion and convective mass transfer in thermal systems.

UNIT I  CONDUCTION  12
General Differential equation of Heat Conduction in Coordinates system – One Dimensional Heat Conduction for Steady State and Unsteady state condition - Extended Surfaces - case studies (real time applications)

UNIT II  CONVECTION  12

UNIT III  PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS  12

UNIT IV  RADIATION  12

UNIT V  MASS TRANSFER  12

L:45; T:15; TOTAL:60 PERIODS

TEXT BOOKS

REFERENCES
13ME62  DESIGN OF TRANSMISSION SYSTEMS  L T P C
3 1 0 4

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Analyze, design and select flexible drive system for any given application
CO2: Formulate design procedures for power transmission between two non-parallel shafts.
CO3: Construct ray diagram and kinematic arrangement of gears to design multi speed gear box.
CO4: Design power screws to transmit power in machine elements.
CO5: Identify, evaluate and compare the functions of different types of brakes, clutches and cams.

UNIT I  DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS  12
Selection of V Belts And Chains: V belts for given power and velocity ratio, selection of micro V-belts, timing belts. Selection of roller chain and power speed ratio, silent chain.
Selection of Belts for Spindle Drive and Feed Drive in Application for CNC Machine Tools: Poly Vee Belts, HTD belts, V-belts of 3V, 5V and 8V types.

UNIT II  SPUR GEARS AND PARALLEL AXIS HELICAL Gears  12
Worm Gears: Nomenclature, thermal capacity, efficiency, design of a pair of worm gears.

UNIT III  DESIGN OF GEAR BOXES  12
Multi Speed Gear Box: Ray diagram, gear tooth profile correction, finalization of the gear train; gear tooth loads and bearing reactions.

UNIT IV  DESIGN OF POWER SCREWS  12
Power Screws: Forms of threads, force analysis, square and trapezoidal threads, collar friction, design of power screws (for screw jack, lathe, etc.,) selection of ball screws.

UNIT V  DESIGN OF CAM, CLUTCHES AND BRAKES  12
Friction Drives: Clutches - role of clutches, positive and gradually engaged clutches, toothed claw clutches, design of single plate and multiple plate clutches, variable speed drives, types and selection. Brakes: Role of brakes-types of brakes-self energizing and de-energizing brakes. Design of internally expanding shoe brakes - calculation of heat generation and heat dissipation in brakes.
Note: (Use of PSG Design Data Book is permitted in the University examination)

L:45; T:15; TOTAL:60 PERIODS

TEXT BOOKS

REFERENCES
13ME63  FINITE ELEMENT ANALYSIS  

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**COURSE OUTCOMES**

Upon completion of this course, the students will be able to

- **CO1:** Apply fundamental concepts of FEA and to select suitable approximate methods to solve mechanical engineering problems.
- **CO2:** Analyze one dimensional Engineering problems using finite element method.
- **CO3:** Select suitable 2D Element to solve structural problem under plane stress and plane strain condition
- **CO4:** Apply the principles of axisymmetric and Isoparametric in Mechanical Engineering problems.
- **CO5:** Formulate and solve basic problems in heat transfer and fluid mechanics

**UNIT I  FEA BASICS AND APPROXIMATION METHODS**


**UNIT II  ONE DIMENSIONAL FINITE ELEMENT ANALYSIS**


**UNIT III  TWO DIMENSIONAL FINITE ELEMENT ANALYSIS**

Dimensionality of a problem-Constant strain triangular element-Shape function, strain displacement matrix, element stiffness matrix, load vectors, Stress calculations, temperature effects-Plane problems of elasticity. Example problems in plane stress and plane strain application - Four noded rectangular element-Shape function, Strains and stresses, Application to solid mechanics problems.

**UNIT IV  AXISYMMETRIC AND ISOPARAMATRIC ELEMENT FORMULATION**

Axisymmetric formulation- Shape function, Element matrices, temperature effects, Stress calculations, Applications to cylinders under internal pressure and rotating discs- Need for Isoparametric formulation-Four noded quadrilateral element - Shape function, Element matrices ,Stress calculation-Coordinate transformation- Numerical Integration

**UNIT V  FEA APPLICATIONS IN HEAT TRANSFER AND DYNAMICS**

1D heat transfer-Element equations-Application to 1D heat transfer problems- Application to heat transfer in 2D - Vibrational problems - Equation of motion based on weak form ,Longitudinal vibration of bars, Transverse vibration of beams, Consistent and Lumped mass matrices for bar and beam element, Simple problems on free vibration of bar and beam.

L:45; T:15; TOTAL:60 PERIODS

**TEXT BOOK**


**REFERENCES**

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Demonstrate the working and use of linear and angular measurement systems.
CO2: Explain the working principle of form measuring instruments.
CO3: Discuss the application of laser and computer aided inspection in metrology.
CO4: Select suitable measuring instruments to measure mechanical parameters.
CO5: Adopt Quality control techniques

UNIT I  LINEAR AND ANGULAR MEASUREMENT  9
Definition of metrology-Linear measuring instruments: Basic design principles, Vernier, micrometer, Slip gauges and classification, interferometry, optical flats, limit gauges- Comparators: Mechanical, pneumatic and electrical types, applications.
Angular measurements: -Sine bar, optical bevel protractor, angle Decker – Taper measurements.

UNIT II  FORM MEASUREMENT  9
Measurement of screw threads-Thread gauges, floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method-gear testing machines – radius measurements-surface finish, straightness, flatness and roundness measurements.

UNIT III  LASER AND ADVANCES IN METROLOGY  9

UNIT IV  STATISTICAL QUALITY CONTROL  9
Process capability, steps in using control charts, basic principles of lot sampling – sampling inspection, single and double sampling, determination of sample size, Operating Characteristic curves (OC), Average Outgoing Quality (AOQ). Design Of Inspection Tools -Design of tool for inspection: gauging design of plug, snap gauges, thread gauges.

UNIT V  QUALITY CONTROL CHARTS  9
Types, Manufacturing specifications, P CHART, np chart, cc chart, u chart, X and R chart- Solving problems using the charts. Design of tool for inspection, Design of plug, snap, thread gauges.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
13ME65  FLUID POWER SYSTEMS  L  T  P  C  3  0  0  3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1:  Identify the fluid power symbols and select suitable fluid for different applications.
CO2:  Select appropriate fluid power driving system and actuators for any given application.
CO3:  Select appropriate fluid power control elements to automate any simple machine.
      Read, construct, analyze and design the fluid power circuit for any real time application.
CO4:  Acquire knowledge on designing of PLC Circuit and real time application of hydraulic &
      Pneumatic circuits.

UNIT I  FUNDAMENTALS OF FLUID POWER SYSTEMS  9
Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations, Properties of
fluids, Fluids for hydraulic systems, governing laws, distribution of fluid power, ISO symbols, energy
losses in hydraulic systems

UNIT II  HYDRAULIC SYSTEM AND COMPONENTS  9
Applications, Basic types and constructions of Hydraulic pumps and motors, Pump and motor analysis,
Performance curves and parameters, Hydraulic actuators, types and constructional details, lever systems.

UNIT III  FLUID POWER CONTROL SYSTEMS  9
Construction of Control Components: Direction control valves, Shuttle valve – check valve – pressure
control valves – pressure reducing valve, sequence valve, Flow control valves – Fixed and adjustable,
electrical control solenoid valves, Proportional control valves and servo valves and its application.

UNIT IV  DESIGN OF FLUID POWER CIRCUITS  9
Design and analysis of typical hydraulic circuits, Regenerative circuits, high low circuits, Synchronization
circuits, and accumulator sizing, Intensifier circuits, Meter-in, Meter-out and Bleed-off circuits; Fail Safe
and Counter balancing circuits, Sequential circuit design for simple applications using cascade method,
accessories used in fluid power system, filtration systems and maintenance of system.

UNIT V  DESIGN OF PNEUMATIC SYSTEMS AND APPLICATION  9
Components of pneumatic systems; FRP, Direction, flow and pressure control valves in pneumatic
systems, Development of single and multiple actuator circuits, Valves for logic functions; Time delay
valve; Exhaust and supply air throttling; Examples of typical circuits using Displacement – Time and
Travel-Step diagrams. Electro-pneumatic control and air-hydraulic control, Ladder diagrams, Applications
in Assembly, Feeding, Metalworking, materials handling and plastics working

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
    2007.
    2002.
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: Conduct heat transfer experiments and analyze experimental data to understand Different modes of heat transfer.
CO2: Conduct experiments on different thermal systems like heat exchangers, air Conditioners, compressors etc., and analyze data to study the performance

LIST OF EXPERIMENTS (Minimum 12 Experiments to be conducted)

1. Thermal conductivity measurement by guarded plate method
2. Thermal conductivity of pipe insulation using lagged pipe apparatus
3. Natural convection heat transfer from a vertical cylinder
4. Forced convection inside tube
5. Heat transfer from pin-fin (natural & forced convection modes)
6. Determination of Stefan-Boltzmann constant
7. Determination of emissivity of a grey surface
8. Effectiveness of Parallel/counter flow heat exchanger
9. Effectiveness of compact heat exchanger
10. Determination of COP of a Vapour compression refrigeration system
11. Experiments on air-conditioning system
12. Performance test on single/two stage reciprocating air compressor.

TOTAL: 45 PERIODS
13ME68  METROLOGY AND MEASUREMENTS LABORATORY  L  T  P  C  
0 0 3 2 

COURSE OUTCOMES 
Upon completion of this course, the students will be able to 
CO1: Demonstrate the use and calibrate the different measuring instruments. 
CO2: Demonstrate the use of different types of comparators. 

LIST OF EXPERIMENTS 
1. Calibration of Vernier / Micrometer / Dial Gauge 
2. Checking Dimensions of part using slip gauges 
3. Measurements of Gear Tooth Dimensions 
4. Measurement of Taper Angle using sine bar 
5. Measurement of tool angles using tool makers microscope 
6. Measurement of straightness and flatness 
7. Measurement of thread parameters 
8. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical) 
9. Measurement of Temperature using Thermocouple / Pyrometer 
10. Measurement of Displacement (Strain Gauge / LVDT / Wheatstone Bridge) 
11. Measurement of Force 
12. Measurement of Torque 

TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: apply the knowledge acquired during the earlier semesters to solve real life problems.
CO2: apply the basic mathematics, science and modern TQM tools to analyze and interpret results.
CO3: analyze the fundamentals of contemporary manufacturing systems and its impact on society and environment.
CO4: demonstrate and solve real life industrial problems and work in groups.
CO5: explain the structured engineering activities carried out in their projects and communicate effectively among their group members and other groups.
CO6: understand the technological and managerial changes in the global scenario and absorb them.
CO7: realize the need for continuous learning after analyzing the strength and weakness analysis.
CO8: plan and manage their projects and summarize effective project reports.

Exercises
Review of various courses learned in the previous semesters will be carried out by maintaining a work book by the students under the guidance of the staff members.
Group activities such as technical debate and presentation on fundamentals of contemporary manufacturing systems including materials, manufacturing process, product and process control, computer integrated manufacture and quality will be conducted.
Student group activities such as conducting experiments and accumulating data in the previous semester laboratory classes will be useful for analyzing and interpreting the results and communicating the outcomes of their work with a brief write up.
Real life industrial problems which they may face in their work place will be analyzed and solutions will be formulated. At least two such problems will be identified and solved by each group of students. The group of students will prepare and submit their project presentation through seminars.
A thirty page summary report should be submitted by each group of students for evaluation. The evaluation is based on continuous assessment by a group of Faculty Members constituted by the professor in-charge of the course.

TOTAL: 45 PERIODS
13MEAA ADVANCED INTERNAL COMBUSTION ENGINES

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: Describe the types, operating parameter, Ideal and Real cycles of IC Engines.
CO2: Discuss about the gas exchange processes including flow of fuel, charging, swirl & squish.
CO3: Explain the mechanism of combustion in SI & CI Engines.
CO4: Explain the formation of different pollutants, measuring and controlling methods and emission norms.
CO5: Discuss the importance of heat transfer in Engine & recent developments in I.C Engines including alternate fuels and Engine Electronic Management.

UNIT I INTRODUCTION

UNIT II GAS EXCHANGE PROCESSES
Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging; Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flow.

UNIT III ENGINE COMBUSTION

UNIT IV POLLUTANT FORMATION AND CONTROL

UNIT V ENGINE HEAT TRANSFER AND RECENT TRENDS

TOTAL: 45 PERIODS

TEXT BOOKS
1. Internal Combustion Engine Fundamentals – John B Heywood

REFERENCES
2. Engineering Fundamentals of the Internal Combustion Engine - Willard W. Pulkrabek
4. R.B.Mathur and R.P.Sharmal, "Internal Combustion Engines".
COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Understand the concepts of solar thermal and its application
CO2: Be familiar with the concept of Energy conversion physics in PV.
CO3: Understand the concepts of extraction of Wind Energy.
CO4: Understand the concepts of various Bio-Energy Conversion techniques
CO5: Be familiar with the concepts of hydrogen and fuel cell technology.

UNIT I  INTRODUCTION TO SOLAR ENERGY     9
Sun – Earth Geometry, solar radiation, Solar Thermal: Basic Concept, types, working principles of different collectors. Application of solar thermal systems.

UNITII  DIRECT ELECTRICITY CONVERSION     9
Direct Electricity Conversion- types and working principle - Basic physics of photovoltaic - Solar photovoltaic system – types of pv systems – Applications and Contributions in Energy Scenario.

UNIT III  WIND ENERGY        9
Wind energy potential, Principle of wind energy conversion; Basic components, types and their constructional features; design considerations: wind data and site selection.

UNIT IV  BIO-ENERGY         9

UNIT V  HYDROGEN AND FUEL CELLS      9

TOTAL: 45 PERIODS

REFERENCES
13MEAC  SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS  L T P C
3 0 0 3

COURSE OUTCOMES
After successfully completing this course student will be able to:
CO1: Understand the fundamentals of solar cells.
CO2: Recognize the various solar PV technologies and their upgrades along with their benefits.
CO3: Design and analyze on-grid and off-grid PV applications
CO4: Realize cost benefit analysis of PV installations

UNIT I  ESSENTIAL BASICS OF SOLAR CELL

UNIT II  COMMERCIAL AND DEVELOPING TECHNOLOGIES
Commercial technologies - Mono crystalline and Multi crystalline, Silicon - Wafer based Solar cell, Thin film solar cells – A-Si, Cd-Te and CIGS, Concentrated PV cells, Developing technologies – Organic cells, Dye sensitized cells.

UNIT III  SOLAR PV FOR ON-GRID APPLICATIONS

UNIT IV  SOLAR PV FOR OFF-GRID APPLICATIONS
Off-Grid stand alone PV system - System sizing – Module and Battery - Storage – Batteries for PV systems – Sun Tracking mechanism – Types of tracking – One-axis, Two-axis - Maximum power point tracking – Design and analysis – Performance evaluation and monitoring - Field visit – Off-grid PV system

UNIT V  COST BENEFIT ANALYSIS FOR SOLAR PV INSTALLATIONS

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
2. Solar Electricity: Engineering of Photovoltaic Systems” by Eduardo Lorenzo, PROGENSA.
4. www.pveducation.org
13MEAD DESIGN OF HEAT EXCHANGER AND PRESSURE VESSEL L T P C 3 0 0 3

COURSE OUTCOMES
After successfully completing this course student will be able to:
- CO1: conceive a design based on the information provided for a particular application
- CO2: learn the sizing of the equipment
- CO3: predict the thermal behavior and carry out a stress analysis
- CO4: come up with a mechanical design as per the relevant codes
- CO5: do the cost economic analysis

UNIT I HEAT EXCHANGER INTRODUCTION 9
Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators – Parts description, classification as per Tubular Exchanger Manufacturers Association

UNIT II DESIGN OF HEAT EXCHANGERS 9
Thermal design using ε-NTU, P-NTU and LMTD methods – Effectiveness - Optimization - Calculation of heat Transfer Coefficient - Calculation of Pressure Drops - Mechanical design of baffles and tube sheets - Complete Problems

UNIT III COMPACT HEAT EXCHANGERS, CONDENSERS, COOLING TOWERS 9
Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations - Design of surface and evaporative condensers – cooling tower – performance characteristics

UNIT IV PRESSURE VESSEL INTRODUCTION, STRESSES IN PRESSURE VESSEL 9

UNIT V DESIGN OF PRESSURE VESSEL 9
Design of Tall cylindrical self supporting process columns – Supports for short vertical vessels – Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement – Pressure Vessel Design.

TOTAL: 45 PERIODS

TEXT BOOKS
2. R.Mukherjee, "Practical thermal design of Shell & Tube Heat Exchanger", Begell House Inc
4. Henry H. Bedner,-"Pressure Vessels, Design Hand Book", CBS publishers and Distributors

REFERENCES
2. T Kuppan, "Heat Exchanger design handbook", Marcel Dekker, INC, 2000
4. ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003
5. Stanley M Wales, Chemical Process equipment, selection and design, Butterworths Series in Chemical Engineering,1988
### COMPOSITE MATERIALS

**Pre-Requisite:**
Basic knowledge in Materials Science

**Course Outcomes**
Upon completion of this course, the students will be able to
- CO1: Describe the classification and basic anatomy of composite materials (Unit-I)
- CO2: Describe the micromechanics and processing methods of MMC and PMC (Unit-II & III)
- CO3: Practice the characterization of composite materials (Unit-IV)
- CO4: Predict failure and design joints in composite materials based on FEM (Unit-V)

**Unit I: Introduction to Composite Materials**

**Unit II: Metal Matrix Composites (MMC) and Polymer Matrix Composites (PMC)**

**Unit III: Fabrication Processes**
Fundamentals - bag moulding - compression moulding pultrusion - filament winding - other manufacturing process - quality inspection and non-destructive testing.

**Unit IV: Testing of Composites**
Introduction to micro-mechanics-unidirectional lamina - laminates – inter-laminal stresses - static mechanical properties - fatigue properties - impact properties - environmental effects - fracture mechanics and toughening mechanisms, damage prediction, failure modes.

**Unit V: Failure Predictions**
Failure predictions - design considerations - joint design - codes - design examples - optimization of laminated composites - application of FEM for design and analysis of laminated composites.

**Total: 45 Periods**

**Text Books**

**References**
1. John cuppoletti, “Metal, ceramic and polymeric composites for various uses”, Intech, 2011
13MEBB NON DESTRUCTIVE TESTING FOR WELDED STRUCTURES L T P C

COURSE OBJECTIVES:
- To provide the personnel with full theoretical and practical knowledge of Penetrant Testing method, ultrasonic Testing, magnetic particle testing, radiographic film interpretation and related standards.
- At the end of the course, the student will be able to undertake Penetrant testing, magnetic particle Testing, Radiography testing film interpretation and Ultrasonic Testing, interpret and evaluate results as per standards.

UNIT I PENETRANT TESTING 7
Introduction & Physics - Penetrant Groups, Types of Developers - Testing techniques - Stages of Penetrant Testing - Inspection Procedures - Selection of Techniques Evaluation of Test Equipment, consumables

UNIT II ULTRASONIC TESTING 12
Introduction to UT - Physics of UT. UT equipment – Probes – purpose, how to use them; cables, connectors, couplants. calibration blocks, reference blocks; purpose, how to use them; cables, connectors, couplants. Test Techniques - Pulse echo, through transmission, resonance techniques and applications, test variables. Testing - calibration of test equipment -Discontinuities, Distance Amplitude Correction (DAC) curve. Testing techniques - method of scanning, scanning pattern, selection of parameters, Testing of Raw material, weld, casting

UNIT III MAGNETIC PARTICLE TESTING 4
Physics of Magnetism - magnetization techniques - magnetic fields - test equipment, accessories, media - Fluorescent, non fluorescent consumables, systems check. TECHNIQUES Testing techniques, interpretation, demagnetisation

UNIT IV RADIOGRAPHIC TESTING FILM INTERPRETATION 8
Overview of RT - Interaction of Radiation with Matter - Radiation safety. Sources of Radiation and their characteristics - Film Radiography - Film Processing. Sensitivity & Definition, I.Q.Is, Other Accessories Techniques in radiography. Manufacturing processes and discontinuities Interpretation & Evaluation of Radiographs, Acceptance Standards Radiographic artifacts

UNIT V CODES AND STANDARDS 2
Codes, Procedures, and Written Practices - Penetrant Testing, Ultrasonic Testing, magnetic particle testing Radiographic Report generation

UNIT VI NDT PRACTICAL 12
Practical 1 PT - Pre-cleaning, etching, Testing - Testing - fluorescent type, visible, comparison of consumables, qualifying of consumables
Practical 2 RT - Familiarization with equipment
Practical 3 RT - calculation of geometric unsharpness – source strength calculations - safe distance - calibration of densitometer
Practical 4 RT - evaluation of radiographs
Practical 5 RT - evaluation of radiographs
Practical 6 MT - Testing of welds – Qualification of equipments
Practical 7 UT - familiarity of equipment - Thickness measurement, sizing of machined reflector – Raw material Testing
Practical 8 UT - calibration of equipment
Practical 9 -UT - DAC - plate 25, 50 mm
Practical 10 UT - weld testing - plate
Practical 11 UT - weld testing - plate
Practical 12 UT - weld testing – plate

TOTAL: 45 PERIODS
REFERENCES
5. ASM Metals Handbook Vol 17 – Non destructive testing, published by ASM, USA
6. ASME Sec V, 2013 Non destructive testing, publ ASME
8. ASTM E165 Standard Practice for Liquid Penetrant Examination for General Industry
11. Industrial Radiography, Image forming Techniques published in Internet by GE Inspection Technologies
12. ASTM -709 Standard Guide for Magnetic Particle Testing
14. ASTM A-578 Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications
15. ASTM E–797 Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method
13MEBC MAINTENANCE ENGINEERING L T P C
3 0 0 3

COURSE OUTCOMES:
Upon successful completion of this course the students will be able to,

CO1: Describe the historical development of maintenance principles and techniques.

CO2: Apply the concept and principle of maintenance processes based on the industry configuration.

CO3: Select, apply and appraise condition monitoring techniques including vibration, thermal techniques and lubricant analysis.

CO4: Identify and apply the various repair methods for basic machine elements.

CO5: Identify repair methods for material handling equipment.

UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

UNIT II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9
Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

UNIT III CONDITION MONITORING 9
Condition Monitoring – Cost comparison with and without CM – On-load testing and off load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9
Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9
Repair methods for Material handling equipment - Equipment records – Job order systems - Use of computers in maintenance.

TEXT BOOKS

REFERENCES
13MEBD ADVANCED COMPUTER AIDED MANUFACTURING L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: Recognize the concept and need of APT, NC and CNC Part Programming.


CO3: Operate CNC Machining through Integration of CAD/CAM software.

CO4: Describe DNC, FMS and Robot technology and also perform simple manufacturing system simulation.

UNIT I COMPUTER NUMERICAL CONTROL
9
Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre-features and applications, Automatic tool changers and Multiple pallet system, types of control systems, CNC controllers, General information on CAM, APT, NC manual part programming, Introduction to CAD/CAM software.

UNIT II NUMERICAL CONTROL CODING AND PROGRAMMING 9
Basic components of an NC system, NC motion control, interpolation, part programming formats, manual part programming, NC coding systems (ISO and EIA)-NC words, macro statements, Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre. Writing simple 2D manual part programming.

UNIT III FEATURES OF CNC, DNC AND DISTRIBUTED NUMERICAL CONTROL 9
Computer Numerical Control (CNC) and DNC: Features of CNC, Elements of CNC machines, the machine control unit for CNC, CNC softwares, direct numerical control, and Distributed numerical control (DNC). Introduction to post processors, general structure and functions of post processor, DAPP based post processor.

UNIT IV CNC TURNING AND MILLING CENTERS 9
Features and selections of CNC turning and milling centers. Practice in part programming and operation of CNC turning machines using NC and APT programming using subroutine techniques and cycles. Practice in part programming and operating a machining center, tool planning and selection of sequence of operations, tool setting on machine.

UNIT V FMS AND ROBOTICS 9
Introduction to FMS, components, applications, benefits, FMS layout, FMS planning and implementation issues. Introduction to robot programming and its languages. Robot simulation using software. Robot path control, preparation of various reports and routs sheets, simulation of simple manufacturing system using any one software.

TOTAL: 45 PERIODS

REFERENCES
13MEBE QUALITY CONTROL OF WELDED STRUCTURES

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: Select appropriate welding process for making welded structures for various material combinations.
CO2: Assess the quality of the welded structure and acquires skills to work as a welding inspector.
CO3: Apply ASME standards to assess the mechanical properties of the weldments for the Welding procedure specification (WPS) and Welder qualification (WQR).
CO4: Practice Visual testing, LPT, MPT, RT and UT to detect defects in weldments.

UNIT I INTRODUCTION TO WELDING PROCESSES 6
Introduction to welding processes- principle - fusion welding - SMAW, SAW, MIG, TIG- equipments – welding techniques.
Welding inspection-weld defects-formation- preventing defects and rectification – weld repair techniques.

UNIT II INTRODUCTION TO QUALITY IN WELDED STRUCTURES 7
Introduction to quality and welded fabrication – quality assurance - quality control – role and responsibilities of a welding inspector.
Quality assurance plan – contents- basis of preparation – implementation - manufacturing quality plan – quality control plan (OCP)

UNIT III QUALITY CONTROL IN WELDING 16
Raw Material Inspection – Types of raw material – plates – pipes, tubes – standard sections – importance of raw material properties for design – ensuring techniques - technical delivery condition document (TDCs) - Indian standard, – raw material standard sizes
Mechanical testing – tensile, bend, hardness, impact – practices as per codes and standards. Chemical testing – ladle testing – product testing
Weld symbols, - Types of welds, types of joints - Edge preparation- purpose - types – comparison of different edge preparations.
Weld fit-up - weld backing - metallic and non-metallic– integral– removable backing - testing of fit up
Visual Inspection of welds –visual testing – gadgets for visual testing – types of weld gages and their application – visual acceptance as per codes and standards – surface defects in welding

UNIT IV QUALIFICATION OF WELDING PROCEDURE AND PERFORMANCE 4
Welding procedure specification (WPS) – purpose– material classification P nos – G nos - WPS as per ASME – establishing WPS – tests for WPS qualification – writing PQR – limits of qualification
Welder qualification (WQR) as per ASME – welding positions - qualifying a welder – Establishing a WQR – limits of qualification

UNIT V PRACTICAL SESSIONS 12
Manufacturing quality Plan evaluation
Study of a typical product drawing - study a MQP for the product – establish the number of tests, documents to be prepared for a product –report preparation
Raw Material TC Reading
Reading IS standard for plate, pipe, rolled sections – preparing list of tests required for the product – reading TC and evaluate whether it meets the standard
Reading Weld Symbols
Reading drawing and establish the types and lengths of welds in the assembly – position of welds –weld document preparation (welding plan)
Welding Procedure Specification (WPS)
Study Procedure qualification record and check its completeness - studying WPS and identify whether it is suitable for particular product

**Welders Qualification Evaluation**

WQR reading – read welder qualification record and check if the welder is suitable for a particular weld.

**Weld Visual inspection & PT**

Evaluation of weld and identification of surface defects – size the weld and establish the acceptance for a particular product – report preparation - Penetrate testing

**Weld inspection - RT evaluation**

RT weld radiograph interpretation

**TOTAL: 45 PERIODS**

**REFERENCES**


3. Welding handbook Vol.1 publisher American welding society


5. Certification Manual for Welding Inspectors by Hobart school of welding

6. Modern welding technology by Howard Cary

7. Metals Handbook Vol.6 Welding, brazing, and soldering by ASM

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: Explain the various welding processes, welding defects and weld repair techniques.
CO2: Describe the quality system practiced in welding process.
CO3: Express the importance of design, mechanical testing and weld symbols.
CO4: Prepare welding procedure specification and welder qualification record.
CO5: Produce product drawing and practice visual inspection of weld joints.

UNIT I  INTRODUCTION TO WELDING PROCESSES    9

UNIT II  INTRODUCTION TO QUALITY ASSURANCE    9

UNIT III  QUALITY CONTROL IN WELDING     9

UNIT IV QUALIFICATION OF WELDING PROCEDURE AND PERFORMANCE        9

UNIT V  PRACTICAL SESSIONS      9
Manufacturing quality plan evaluation -Typical product drawing - study a MQP for the product – establish the number of tests, documents - prepare the reports. Raw Material TC Reading- Read a IS standard for plate, pipe, rolled sections – prepare a list of tests – read a TC and evaluate. Reading Weld Symbols - read a drawing and establish the types and lengths of welds in the assembly – position of welds – prepare weld documentation (weldingplan). Welding Procedure Specification (WPS) - Procedure qualification record and check its completeness – study a WPS and identify whether it is suitable for a particular product – Welder Qualification Evaluation – WQR reading – read welder qualification record and check. Weld visual inspection - Evaluate a weld and identify the surface defects – size the weld and establish the acceptance – make a report.

TOTAL: 45PERIODS

REFERENCES
1. Welding handbook Vol 1 publisher American welding society
3. Certification Manual for Welding Inspectors by Hobart school of welding
4. Modern welding technology by Howard Cary
5. Metals Handbook Vol.6 Welding, brazing, and soldering by ASM
COURSE OUTCOMES
Upon completion of this course, the students will be able to
   CO1: Express the process of product design
   CO2: Analyze the economic issues in product design
   CO3: Describe product modeling
   CO4: Discuss the various cost involved in the product development
   CO5: Discriminate the industrial design process and quality assessment methods

UNIT I   PRODUCT DESIGN AND DEVELOPMENT  8

UNIT II  ECONOMICS OF DESIGN  9
Breaks even point - Selection of optimal materials and processes – Material layout planning – Value analysis – Re-engineering and its impact on product development.

UNIT III  PRODUCT MODELING  9

UNIT IV  PRODUCT COSTING  10
Bill of materials – Outline Process charts – Concepts of operational standard time - Work measurement by analytical estimation and synthesis of time – Budgets times – Labor cost and material cost at every stage of manufacture – W.I.P. costing

UNIT V   INDUSTRIAL DESIGN  9
Need for industrial design – Impact of industrial design – Industrial design process – Management of industrial design process – Assessing the quality of industrial design, design for manufacturing - cost considerations, Impact of DFM decisions on other factors.

TOTAL: 45 PERIODS

REFERENCES
13MEBH CREATIVITY, INNOVATION AND PRODUCT DEVELOPMENT L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
- CO1: Demonstrate the concepts in creativity and innovation.
- CO2: Evaluate the new project planning
- CO3: Identify new products for commercialization
- CO4: Discuss the importance of Intellectual Property Rights (IPR)

UNIT I CREATIVITY
9
Concept and history of creativity, need for creativity, creative environment, stages of creativity process, creativity and intelligence, creativity in various contexts, economic view of creativity, measuring creativity, fostering creativity, creative problem solving – brainstorming and various techniques, lateral thinking. Role of creativity in entrepreneurship – Research and development (R & D). Case studies on creative solutions to contemporary issues.

UNIT II INNOVATION
9
Definition, creativity vis-à-vis innovation, conceptualizing innovation, types of innovation, sources of innovation, goals of innovation, process of technological innovation, diffusion of innovation, factors contributing to successful technological innovation, failure of innovations, innovation management, measures of innovation.
Case studies - Innovations in health sector, agriculture, education, entrepreneurship, and Corporate R&D.

UNIT III PROJECT PLANNING AND EVALUATION
9
Definition and purpose of project, collection of ideas, screening ideas, selection criteria for new projects, development of project plan, project evaluation – purpose, kinds of evaluation, stages of evaluation process, techniques of project evaluation, project analysis, benefits and risks of new projects.

UNIT IV PRODUCT DEVELOPMENT AND EVALUATION
9
Research and new product development – process and types of new products, creative design, design of prototype – purpose, process, and types, model preparation, testing and quality evaluation; marketing research – purpose and process, types and methods; introducing new products, cost evaluation. Product deployment and commercialization - Case Studies.

UNIT V PROTECTION OF INNOVATION
9
Intellectual property (IP), classes of IP – industrial property and copyrights; Intellectual Property Rights (IPR); Patents, patentability, patent acts, governing laws, history of patent laws and acts, patent administration; patenting process – patent application, patent search, prosecution, publication, examination, opposition, grant, renewal, patent rights; international code for patents, patents vis-à-vis economics.

TOTAL: 45 PERIODS

REFERENCES
1. Frederick Betz, Managing Technological innovation, John Wiley & Sons, Inc., Third Edition
COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: Describe the basic concepts of types of vibration and vibration control
CO2: Analyze the vibration generation mechanism
CO3: Explain the passive vibration control techniques
CO4: Discuss the active vibration control methods
CO5: Articulate the vibration measurement and analysis techniques

UNIT I BASIC CONCEPTS
Review of free and forced vibrations with and without damping; Free and forced vibration of single, two and multi-degree of freedom systems with and without viscous damping. Vibration reduction at source, Active feedback control, vibration isolation

UNIT II VIBRATION GENERATION MECHANISM
Vibration generation mechanisms: Source classification, self excited vibration, flow induced vibration, field balancing of rigid rotors/flexible rotors and damping models and measures, Design consideration of material selection.

UNIT III PASSIVE VIBRATION CONTROL
Basics, design of absorber, absorber with ideal spring, shock absorber, isolators with stiffness and damping.

UNIT IV ACTIVE VIBRATION CONTROL
Basics, Piezoelectric materials, electro rheological fluids, magnetorheological fluids, Magneto and Electrostrictive Materials in Vibration Control, shape memory alloys and electromagnetic materials.

UNIT IV VIBRATION MEASUREMENT
Basics, data acquisition, FFT analysis and filters

TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: Apply the fundamental principles for designing pipes and creating engineering drawings.

CO2: Explain the working principle of piping components and Design pipes for various piping codes and standards.

CO3: Analyze the stress induced in the pipes under static loading condition.

CO4: Design pipes and piping support structures considering welding reinforcement and stress intensifications.

CO5: Predict mathematically the behavior of pipes under dynamic conditions.

UNIT I  FUNDAMENTALS

UNIT II  PIPING ELEMENTS AND MATERIALS

UNIT III  PIPING SUPPORTS AND STATIC STRESS ANALYSIS

UNIT IV  WRC AND SIF IN PIPING
Welding reinforcement calculations – Nozzle design - Stress intensification at elbows, tees and branch – Structure basics - Piping supporting structure modeling.

UNIT V  DYNAMIC ANALYSIS
Wind and Seismic analysis – Damping – Lumped Mass – Steady state vibration and harmonic analysis – Time history Analysis

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES
13MECC ADVANCED MODELING TECHNIQUES L T P C 2 0 2 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: Describe the principles and concepts of Geometric modeling, solid modeling, and assembly.

CO2: Apply advanced modeling and computational tools for complex mechanical parts.

CO3: Produce detailed exploded assembly views with Bills of Materials

CO4: Execute element and sheet metal CAD drawings for mechanical engineering applications in the current industrial practice.

CO5: Create and export computer-generated animations showing the assembly and operation of mechanical problems.

UNIT I MODELING CORE CONCEPTS 9

UNIT II ADVANCED PARTS AND ASSEMBLY 9
Sketch – 3D Sketch, Parabola, Conics, Splines, Derived sketches. Part – Flex, Bending, Twisting, Tapering and stretching, splitting, Multi body Configurations. Assembly – Flexible sub assembly, Path, linear coupler, Gear, Cam, Screw, Limit and Hinge mates, Assembly Configurations.

UNIT III ADVANCED DRAWINGS 9
Model view, Projection view, Section view, Detail view, Broken view, Exploded view, Dimensions – ordinate, driving, baseline, annotations, ballons, Bill of materials, tables, Tolerances. Geometric Dimensioning and Tolerance.

UNIT IV WELDMENT AND SHEET METAL 9
Weldment – Structural members, Trim Extend, Gusset end caps, Weld beads, Cut List, Sub- weldment, Custom profiles. Sheet Metal – Cone, Cylinder, Lofts, Base Flange, Edge Flange, Swept Flange, Mitre Flange, sketched bend, Jog, Hem.

UNIT V ANIMATIONS AND ADVANCED CONCEPTS 9
Animations – walkthrough videos, Tool Analyst, Photoview, Rendering, Mold, Plastics, Introduction to CAM.

REFERENCES

TOTAL: 45 PERIODS
13MECD      NEW PRODUCT DESIGN AND DEVELOPMENT      L  T  P  C
                        3  0  0  3

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
   CO1: Recognize the basic concepts of product design and development with focus on the
         Product Initiation, development techniques, Quality Concepts and Product legality.

UNIT I    PRODUCT INITIATION    12
Product Identification, identifying customer needs, need for developing products, market research,
   design goals, specifications, industrial design, concept designs, creativity, out of box ideas, on the fly
   design, evolved design, Emotional Design, Innovative products, Re Engineering products, Reverse
   Engineering products,

UNIT II  PRODUCT DEVELOPMENT    11
Various stages of product development, Ergonomics, structural design, modular design, Need of
   prototypes, Various Prototyping techniques, Rapid prototyping, Concurrent engineering, reliability,
   endurance, Product Data Management

UNIT III  QUALITY CONCEPTS    11
Design for quality, Quality Function Deployment, Design Of Experiments, Failure Modes & Effect
   Analysis, TQM, design for six sigma, brain storming techniques, Design for manufacturing,

UNIT IV  PRODUCT LEGALITY    11
Product standards, Drawing standards, product certifications, system certifications, Patent, copy right,
   trademarks, geographical indication

TOTAL: 45 PERIODS

REFERENCES
1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development “, 4th
   6/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book
4. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN
   Reprint, 2009.
COURSE OUTCOMES

Upon completion of this course, the students will be able to

CO1: Recognize the need for total quality management and areas of application of this management concept.

CO2: Predict the need for customer expectations and employee involvement.

CO3: Estimate six-sigma and perform benchmarking.

CO4: Devise methods to use Quality Function Deployment (QFD), failure Mode Effect Analysis (FMEA) and Taguchi’s loss functions.

CO5: Describe ISO 9000 and Environmental Management System (EMS) standards.

UNIT I  INTRODUCTION

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM - Contributions of Deming, Juran and Crosby – Cost of Quality, Analysis Techniques for Quality Costs – Barriers to TQM.

UNIT II  TQM PRINCIPLES


UNIT III  TQM TOOLS AND TECHNIQUES I

The seven traditional tools of quality – New management tools – Deviation and Standard Deviation; Phases and Defective Units of Six Sigma; Its Importance; Overview of Master Black and Green Belt–Bench marking– Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV  TQM TOOLS AND TECHNIQUES II


UNIT V  QUALITY SYSTEMS


TOTAL: 45 PERIODS

TEXT BOOKS


REFERENCES


FEW HYPERLINKS FOR REFERENCES
- http://nptel.ac.in/courses/110101010/16
13MEDB ENTREPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
CO1: describe the concept of entrepreneurship and need for becoming an entrepreneur.
CO2: discuss about competencies and motivation acquired for an entrepreneur.
CO3: demonstrate their plan to start a small enterprise.
CO4: analyze the financial and accounting details needed for starting and running a small enterprise.
CO5: summarize the various supports available to start a small enterprise.

UNIT I ENTREPRENEURSHIP 9

UNIT II ENTREPRENEURIAL MOTIVATION AND COMPETENCIES 9

UNIT III BUSINESS 9

UNIT IV FINANCING AND ACCOUNTING 9

UNIT V SUPPORT TO ENTREPRENEURS 9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES