B.E. MECHANICAL ENGINEERING

CURRICULUM

(2019 AND ONWARDS)

(PART TIME PROGRAMME)

Department of Mechanical Engineering
FACULTY OF ENGINEERING

KARPAGAM ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

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(Deemed to be University)
Established Under Section 3 of UGC Act 1956
Pollachi Main Road, Eachanari Post, Coimbatore – 641 021. INDIA
### SEMESTER I

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<th>Course Code</th>
<th>Course title</th>
<th>Objectives &amp; Outcomes</th>
<th>Instruction Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>19PBEME7E06</td>
<td>Composite Materials</td>
<td>1, 2, 3, 5, 6, 8, 9</td>
<td>3 0 0 3</td>
<td>40</td>
<td>60 100</td>
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<tr>
<td>19PBEME7E07</td>
<td>Quality Control and Reliability Engineering</td>
<td>1, 3, 4, 7, 9, 11</td>
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<td>19PBEME7E08</td>
<td>Non Destructive Testing</td>
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<td>19PBEME7E09</td>
<td>Industrial Safety Engineering</td>
<td>1, 3, 2, 3, 4, 6, 7, 8, 9, 10</td>
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<tr>
<td>19PBEME7E10</td>
<td>Industrial Robotics</td>
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<td>60 100</td>
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</table>

**Total number of credits: 104**

- **L:** Lecture Hour
- **T:** Tutorial Hour
- **P:** Practical Hour
- **CIA:** Continuous Internal Assessment
- **C:** No. of Credits
- **ESE:** End Semester Examinations
COURSE OBJECTIVES
The objective of this course is
1. To familiarize the prospective engineers with techniques in calculus, and multivariate analysis.
2. To familiarize the prospective engineers with techniques in linear algebra.
3. To equip the students with standard concepts and tools at an intermediate to advanced level.
4. To equip the students with the necessary tools for more advanced level of mathematics.
5. To make the students aware of the useful applications in their disciplines.
6. To make the students capable of solving real-time problems using standard concepts and tools.

COURSE OUTCOMES
The students will learn:
1. To apply differential and integral calculus to notions of curvature and to improper integrals.
2. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.
4. To deal with functions of several variables that are essential in most branches of engineering.
5. The essential tools of matrices and linear algebra in a comprehensive manner.
6. Students can solve real time problems using standard concepts and tools.

UNIT I  MATRICES  9+3

UNIT II  DIFFERENTIAL CALCULUS  9+3
Overview of Derivatives - Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes

UNIT III  DIFFERENTIAL EQUATIONS  9+3
Introduction to Ordinary differential equations: linear ordinary differential equations of second and higher order with constant coefficients.
Introduction to Partial differential equations - Linear partial differential equations of second and higher order with constant coefficients

UNIT IV  ANALYTIC FUNCTIONS  9+3
Analytic functions – Necessary and Sufficient conditions for an analytic function (Without proof) Cauchy-Riemann equations –Harmonic –Properties of analytic functions- Constructions of an analytic function - Conformal mapping: w = z+a, az, 1/z and bilinear transformation

UNIT V  Z -TRANSFORM AND DIFFERENCE EQUATIONS  9+3

TOTAL  45 + 15 = 60 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To develop capacity to predict the effect of force and motion.
2. To understand the importance of free body diagram for complex machine structure.
3. To perform force analysis using law of mechanics.
4. To introduce the concepts of static equilibrium condition for particles and rigid bodies
5. To understand the concepts of kinematics of particles and friction.
6. To make the students conversant to solve the problems using equation of motions.

COURSE OUTCOMES
At the end of the course the students will be able to
1. Understand the basic concepts of force and laws of mechanics.
2. Develop free body diagram for complex machine structure and to perform force analysis.
3. Apply static equilibrium condition for particles and rigid bodies.
4. Locate the center of gravity and moment of inertia for planes and solids.
5. Understand the concepts of kinematics of particles and friction.
6. Solve the problems using equation of motions.

UNIT I  STATICS OF PARTICLES
Forces – system of forces – concurrent forces in plane and space– resultant – problems involving the equilibrium of a particle–free body diagram–equilibrium of particle in space.

UNIT II  STATICS OF RIGID BODIES IN TWO DIMENSIONS

UNIT III  CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA
Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia – radius of gyration – mass moment of inertia of simple solids.

UNIT IV  KINEMATICS OF PARTICLES


UNIT V  KINETICS OF PARTICLES AND FRICTION


TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To provide an overview of various analog device
2. To provide an overview of Digital concepts
3. To learn working of amplifier and its application.
4. To understand the concept of RC-timing circuits.
5. To learn cellular concept and block diagram of GSM system.
6. To provide a review of communications system.

COURSE OUTCOMES
At the end of the course the students will be able to
1. Understand the principles of semiconductor devices and their applications.
2. Understand the concept of voltage regulators.
3. Design an application using Operational amplifier.
4. Understand the working of timing circuits and oscillators.
5. Understand logic gates, flip flop as a building block of digital systems.
6. Learn the basics of Electronic communications system.

UNIT I ELECTRIC CIRCUITS & MEASUREMENTS

UNIT II ELECTRICAL MACHINES

UNIT III MEASURING INSTRUMENTS
Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT IV SEMICONDUCTOR DEVICES AND APPLICATIONS

UNIT V DIGITAL ELECTRONICS

SUGGESTED READINGS

TOTAL 45 PERIODS
COURSE OBJECTIVES
1. To familiarize the students to apply suitable molding and casting methods for producing components.
2. To develop an understanding of types of metal joining processes.
3. To explain types of deformation processes.
4. To understand the concept of sheet metal operations and metal forming processes.
5. To provide an overview of various plastic component manufacturing processes for various applications.
6. To study and acquire knowledge of process variables to manufacture defect-free products.

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Apply suitable molding and casting methods for producing components.
2. Decide the type of metal joining processes.
3. Select the type of deformation processes.
4. Work with various sheet metal operations and metal forming processes.
5. Select the various plastic component manufacturing processes for various applications.
6. Identify the effect of process variables to manufacture defect-free products.

UNIT I FOUNDRY EQUIPMENTS AND MATERIALS
Patterns. Moulds-types of moulds, moulding sand characteristics and testing procedures. Core making, melting furnaces.

UNIT II PRODUCTION OF CASTINGS

UNIT III WELDING

UNIT IV METAL FORMING PROCESSES
Cold and hot working, rolling, drawing, extrusion and forging, sheet metal cutting, bending. Drawing applications, defects. Types of presses.

UNIT V SPECIAL FORMING METHODS
Explosive forming, electromagnetic forming, electro hydraulic forming, powder metallurgy process, composite mouldings.

INTRODUCTION TO SOFTWARE FOR MANUFACTURING APPLICATIONS (Not for exam)
Metal forming and flow analysis software (for metallic/plastic components).

SUGGESTED READINGS
5. Phillip F. Ostwald, Jairo Munoz, Manufacturing Processes and Systems, 9ed, John Wiley and Sons, 2005
COURSE OBJECTIVES
1. To gain practical experience in handling 2D drafting and 3D modeling software systems.
2. To impart training on SOLID WORKS for modelling
3. To provide knowledge on assembly of components
4. To facilitate the understanding of manufacturing drawings from the models created
5. To equip them with skills to Construct an assembly drawing using part drawings of machine components.
6. To equip them with skills to Construct an assembly drawing of machine components using 2D drafting.

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. use computer and CAD software's for modeling of mechanical components
2. use various options in Solid Works for modeling of given components
3. create assembly of components
4. Make part drawings from an assembly drawing.
5. Interpret the details of complex parts in cross section views.
6. Sketch production drawing from assembly drawing.

COMPUTER AIDED DESIGN
1. 3D modeling of various machine elements using various options like protrusion, cut, sweep, draft, loft, blend, rib.
2. Assembly – creating assembly from parts – assembly constraints
3. Conversion of 3D solid model to 2D drawing – different views, sections, isometric view and dimensioning.
4. Introduction to Surface Modeling.
5. Introduction to File Import, Export – DXF, IGES, STL, STEP

Note: Any one of the 3D MODELING software’s like SOLIDWORKS, CREO, CATIA, NX Software, AutoCAD etc.

TOTAL 45 PERIODS
COURSE OBJECTIVES
The objective of this course is
1. To familiarize the prospective engineers with techniques in Multivariate integration.
2. To familiarize the concept of ordinary and partial differential equations and complex variables.
3. To equip the students to deal with advanced level of mathematics and applications.
4. To make the students to formulate and solve problems involving random variables.
5. To equip the students to Understand the basic concepts of one- and two-dimensional random variables.
6. To understand the concept of testing of hypothesis for small and large samples in real life problems.

COURSE OUTCOMES
The students will learn:
1. The mathematical tools needed in evaluating multiple integrals and their usage.
2. The effective mathematical tools for the solutions of differential equations that model physical processes.
3. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering Problems.
4. Understand the basic concepts of one- and two-dimensional random variables and apply in engineering applications.
5. They can also formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data
6. Apply the concept of testing of hypothesis for small and large samples in real life problems.

UNIT I MULTIPLE INTEGRALS
Double integration – Cartesian coordinates – Polar coordinates – Change of order of integration – Triple integration in Cartesian co-ordinates – Area as double integrals.

UNIT II VECTOR CALCULUS
Gradient, Divergence and Curl – Directional derivative – Irrotational and Solenoidal vector fields – Vector integration - Green’s theorem, Gauss divergence theorem and Stoke’s theorems (Statement only)- Surfaces : hemisphere and rectangular parallelepipeds

UNIT III FOURIER SERIES

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS
Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded).

UNIT V LAPLACE TRANSFORMS

TOTAL \( 45 + 15 = 60 \) PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES

1. To understand the concepts of stress and strain on deformation of solids.
2. To introduce the Concepts of safe working stresses and load carrying capacity of beams.
3. To understand the importance of the effect of torsion on shafts and springs.
4. To provide knowledge on principal stresses and analyze thin cylinders and shells subjected to pressure forces.
5. To provide knowledge on components subjected to various loadings with the help of various theories of failures.

COURSE OUTCOMES

1. Determine stress and strain on deformation of solids.
2. Compute safe working stresses and load carrying capacity of beams.
3. Estimate the deflection in beams and columns in engineering applications.
4. Analyze the effect of torsion on shafts and springs.
5. Determine principal stresses and analyze thin cylinders and shells subjected to pressure forces.
6. Design the components subjected to various loadings with the help of various theories of failures.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

UNIT II BEAMS – LOADS AND STRESSES

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams – Relationship between load, shear force and bending moment – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

UNIT III BEAM DEFLECTION


UNIT IV TORSION

Analysis of torsion of circular bars – Torsional shear stress – Bars of solid and hollow circular section – Stepped shaft – Torsional rigidity – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads

UNIT V ANALYSIS OF STRESSES IN TWO DIMENSIONS

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr’s circle for biaxial stresses – Maximum shear stress – Strain energy in bending and torsion.

TOTAL 45 PERIODS

SUGGESTED READINGS

COURSE OBJECTIVES

1. To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and cam mechanisms for specified output motions.
2. To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.
3. To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
4. To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
5. To expose students to vibration phenomenon and its types along with the vibration terminologies.
6. To understand the effect of Dynamics of undesirable vibrations.

COURSE OUTCOMES

Upon completion of this course, the students can able to
1. Identify the type and mechanism and will be able to perform velocity and acceleration analysis
2. Classify the types of friction and understand the friction applications used in screw threads, clutches, brakes.
3. Specify the gear terminology and to select appropriate gear trains for engineering applications.
5. Describe the vibration phenomenon and its types along with the vibration terminologies.
6. Analyze the systems subjected to vibration

UNIT I MECHANISMS

UNIT II KINEMATICS
Surface contacts–Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt and rope drives, Friction aspects in Brakes.

UNIT III KINEMATICS OF CAM
Gear profile and geometry – Nomenclature of spur and helical gears – Gear trains: Simple, compound gear trains and epicyclic gear trains - Determination of speed and torque- Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller ended followers with and without offsets for various types of follower motions.

UNIT IV GEARS

UNIT V FRICTION IN DRIVES

TOTAL 45 PERIODS

SUGGESTED READINGS
5. Thomas Bevan, Theory of Machines, 3e, CBS Publishers and Distributors, New Delhi, 2005
6.
COURSE OBJECTIVES
1. To have knowledge on computer hardwares and softwares
2. To understand the various data representation techniques
3. To make the students to get knowledge on software engineering methodologies
4. To know the correct and efficient ways of solving problems
5. To learn to develop algorithm for simple problem solving
6. To learn to program in C

COURSE OUTCOMES
At the end of the course, the student will understand the software
1. To formulate simple algorithms for arithmetic and logical problem.
2. To translate the algorithms to programs (in C language
3. To test and execute the programs and correct syntax and logical error
4. To implement conditional branching, iteration and recursion
5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach
6. To use arrays, pointers and structures to formulate algorithms and programs

UNIT I COMPUTER BASICS
Evolution of computers- Generations of computers- Classification of computers- Applications of computers- Computer Organization and Architecture- Computer Memory and Storage- Input Output Devices

UNIT II SOFTWARE, PROGRAMMING AND INTERNET
Algorithm- Flowchart- Pseudo code – Program control structures- Programming paradigms- Programming languages-Generations of Programming languages- Computer Software- Definition- Categories of Software - Internet- Evolution-Basic Internet terms- Internet-Applications

UNIT III C FUNDAMENTALS
Introduction to C- Constants- Variables- Data types- Operators and Expressions-Managing Input and Output operations- Decision Making and Branching- Looping

UNIT IV ARRAYS AND FUNCTIONS
Arrays- Character Arrays and Strings- User defined functions- Storage Classes

UNIT V STRUCTURES AND FILES
Structures- Definition- Initialization- Array of Structures- Structures within structures- Structures and Functions- Unions-File Management in C

TOTAL 45 PERIODS

SUGGESTED READINGS
2. ITL Education Solutions Ltd, Introduction to Information Technology, Pearson Education. Delhi, 2008
19PBEME211 STRENGTH OF MATERIALS LABORATORY SEMESTER – II 3H: 2C

Instruction Hours / Week: - L: 0  T: 0  P: 3  Marks: - Internal: 40  External: 60  Total: 100
End Semester Exam:  3 Hours

COURSE OBJECTIVES
1. To perform different destructive testing
2. To learn the characteristic materials
3. To understand the stress and strain relationship.
4. To determine the shear force for various materials.
5. To determine the impact load for various materials.
6. To determine the hardness for various materials

COURSE OUTCOMES
1. Ability to perform different destructive testing
2. Ability to characteristic materials
3. Understand the stress and strain relationship.
4. Determine the shear force for various materials.
5. Determine the impact load for various materials.
6. Determine the hardness for various materials

LIST OF EXPERIMENTS
1. Tensile test on metals–stress strain characteristics
2. Cupping test on metal sheets–load deformation characteristics, cupping load, cupping number.
3. Hardness test on metals–Brinell, Vicker and Rockwell Hardness tests.
4. Impact test on metals–Charpy, Izod impact tests.
5. Shear test on metals–direct shear strength, single shear, double shear.
7. Torsion test on beams–torque and angle of twist characteristics, shear stress, modulus of rigidity, energy.

TOTAL  45 PERIODS
19PBEME301  THERMODYNAMICS  SEMESTER – III  4H: 4C

Instruction Hours / Week:  L: 3  T: 1  P: 0  Marks: - Internal: 40  External: 60  Total: 100  End Semester Exam:  3 Hours

COURSE OBJECTIVES
1. To understand the model of physical systems into relevant thermodynamic system and apply energy balance equation for closed and open system.
2. To provide knowledge on entropy change in thermodynamic processes.
3. To Study and acquire knowledge on various thermodynamic properties of pure substances in real time problems.
4. To establish the basic thermodynamic relations and properties of ideal and real gases for physical systems.
5. To facilitate the understanding of properties of air using psychrometric chart.
6. To acquaint the student with the concepts and applications of the thermodynamics to the various real-life systems.

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Understand the first law and able to differentiate closed and open system, also able to apply first law to both types of systems
2. Define the physical description of second law and its application to heat engine, refrigerator and heat pump.
3. Also understand the concepts of entropy and able to find out the entropy generated in a thermodynamic systems
4. Understand the properties of pure substance and ideal gas concepts
5. Describe the importance of availability concept and able to apply the thermodynamic relations in applications.
6. Understand the psychometric properties and various processes to create human comfort at various physical conditions

UNIT I  BASIC CONCEPTS AND FIRST LAW  9+3

UNIT II  SECOND LAW AND ENTROPY  9+3
Physical description of the second law - Kelvin-Planck and Clausius statements –Equivalence - Reversible processes and cycles- Carnot cycle – Corollaries - Absolute temperature scale – Clausius Theorem, inequality - Entropy- Principle, transfer, generation, balance - Third law of thermodynamics

UNIT III  THERMODYNAMIC AVAILABILITY AND RELATIONS  9+3

UNIT IV  PROPERTIES OF PURE SUBSTANCE AND GAS MIXTURES  9+3

UNIT V  PSYCHROMETRY  9+3
Psychrometry - Psychrometric charts - Property calculations of air vapour mixtures- Psychrometric process-Adiabatic mixing - Evaporative cooling

TOTAL  45 + 15 = 60 PERIODS

(Permitted to use standard thermodynamic table, Mollier diagram, and Psychometric chart in the examination)

SUGGESTED READINGS
2. Cengel, Thermodynamics-An Engineering Approach, 8e, Tata McGraw-Hill, New Delhi, 2015
5. Kothandaraman C P and Domkundwar S, A Course in Thermal Engineering, Dhanpatrai& Sons, New Delhi, 2004
COURSE OBJECTIVES
1. To impart knowledge on metallurgical aspects of metals.
2. To understand heat treatment processes on different grades of steel.
3. To familiarize on selection of ferrous and non-ferrous materials for various applications.
4. To impart knowledge on non-metallic materials.
5. To learn about the strengthening mechanisms for Non-ferrous alloys.
6. To comprehend the significance of Non-Destructive Testing (NDT) methods.

COURSE OUTCOMES
Learners should be able to:
1. Identify the metallurgical aspects of metals.
2. Identify suitable heat treatment processes for various applications.
3. Select appropriate ferrous and non-ferrous materials for various applications.
4. Identify and select suitable non-metallic materials.
5. Identify suitable strengthening mechanisms for Non-ferrous alloys.
6. Work with non-destructive testing methods.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS

UNIT II HEAT TREATMENT

UNIT III FERROUS AND NON FERROUS METALS

UNIT IV NON-METALLIC MATERIALS
Polymers – types of polymer, commodity and engineering polymers – Properties and Applications of thermoplastics (PP, PVC, ABS, and PMMA) and thermosetting plastics (PF, UF, MF) – Engineering Ceramics.

UNIT V TESTING OF MECHANICAL PROPERTIES AND INSPECTION
Non Destructive Testing: Non Destructive Testing basic principles and testing method of Radiographic testing, Ultrasonic testing, Magnetic particle test and Liquid penetrant test, Eddy current testing.

TOTAL 45 PERIODS

SUGGESTED READINGS
4. James F. Shackelford
COURSE OBJECTIVES
1. To provide knowledge on various Metrological equipments available to measure the dimension of the components
2. To learn the importance of precision measurements.
3. To understand the concepts of linear and angular measurements.
4. To study different profile measurements used in practice.
5. To acquire knowledge on laser measurements and CMM.
6. To gain knowledge on measurement of mechanical and thermal quantities.

COURSE OUTCOMES
Upon completion of this course, the Students can
1. Understand the basics of measurements and quality standards
2. Apply the concept of measurements in practical applications.
3. Measure linear and angular measurements.
4. Carry out profile measurements in engineering components.
5. Exhibit measurements in practice using laser and CMM.
6. Perform measurements on mechanical and thermal quantities

UNIT I BASICS OF MEASUREMENT, DEVICES AND QUALITY STANDARDS
Definition of metrology, economics of measurement, measurement as a comparative process, dimensional properties, terminology and accuracy of measurement, measuring errors, Abbe’s Principle, Principle of interferometry- flatness testing, optical interferometer, laser interferometer. Holography and speckle metrology.

UNIT II LINEAR MEASUREMENTS
Material length standards – line and end measurement – calibration of end bars, datum and reference surfaces, surface plates, gauges – feeler gauges, micrometers, dial test indicator, slip gauges, care of gauge blocks, Comparators- mechanical, electrical, optical and pneumatic, optical projector.

UNIT III GEOMETRICAL MEASUREMENT
Angular measurement – plain vernier and optical protractors, sine bar, optical instruments, flatness, parallelism and roundness measurement, need for limit gauge, design of plug gauge, Taylor’s principle, three basic types of limit gauges, surface texture, reasons for controlling surface texture, parameters used, specification of surface texture, drawing and symbols, Tomilson surface meter. CMM.

UNIT IV METROLOGY OF MACHINE ELEMENTS
Types of screw threads, terminology, proportions of ISO metric thread, measurement of major, minor and effective diameters. Gear terminology and standard proportions, spur gear measurement, checking of composite errors, base pitch measurement, clean room environment.

UNIT V MACHINE INSTALLATION AND TESTING
Equipment erection, commissioning, testing procedure for lathe, milling, continuous process line. First aid, safety precautions in installation of equipment, protocol for repair and testing, inspection check list.

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To enrich the understanding of fluid properties
2. To make the students conversant with types of flow and calculate Major and minor losses in pipes.
3. To acquaint the student with the concepts of Buckingham’s π theorem.
4. To explain the working of different pumps
5. To explain the working of different turbines.
6. To equip students with skills to produce analytical solutions to various simple problems

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Demonstrate basic knowledge of fluid properties
2. Find types of flow and calculate Major and minor loses in pipes.
3. Apply Buckingham’s π theorem for problem solving.
4. Understand the working of different pumps
5. Understand the working of different turbines.
6. produce analytical solutions to various simple problems

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS
Fluid properties: Mass density, weight density, specific gravity, viscosity, compressibility, surface tension and capillarity.
Buoyancy and floatation– metacentre and metacentric height (definition only)
Flow characteristics: concepts of system and control volume, application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation.

UNIT II FLOW THROUGH CIRCULAR PIPES

UNIT III DIMENSIONAL ANALYSIS
Dimension and units, dimensional homogeneity, applications of Buckingham’s π theorem, model and similitude, similarity laws.

UNIT IV HYDRAULIC TURBINES

UNIT V HYDRAULIC PUMPS

TOTAL 45 PERIODS

SUGGESTED READINGS
2. Kumar K.L, Engineering Fluid Mechanics, S. Chand, 2015
5. Fox and McDonald, Fluid Mechanics, 8e, John Wiley, 2015
19PBEME311 FLUID MECHANICS AND METROLOGY SEMESTER – III LABORATORY

Instruction Hours / Week: - L: 0  T: 0  P: 3  Marks: - Internal: 40  External: 60  Total: 100
End Semester Exam:  3 Hours

COURSE OBJECTIVES
1. To supplement the theoretical knowledge gained in Fluid Mechanics and Machinery with practical testing
2. To understand the concepts of coefficient of discharge for Orifice meter and Venturi meter, Rotameter.
3. To understand the importance of friction factor for flow through pipes, performance of various pumps and turbines
4. To introduce the concepts to Characterize and calibrate measuring devices.
5. To expose students to measuring taper angle straightness, flatness, surface finish and thread parameters.
6. To explain the limits of dimensional tolerances using comparators.

COURSE OUTCOMES
1. Calculate the coefficient of discharge for Orifice meter and Venturimeter, Rotameter
2. Estimate the friction factor for flow through pipes, performance of various pump
3. Determine of jump speed and profile of the cam, moment of inertia by oscillation method for connecting rod and flywheel.
5. Measure taper angle straightness, flatness, surface finish and thread parameters.
6. Examine the limits of dimensional tolerances using comparators.

LIST OF EXPERIMENTS

• FLUID MECHANICS
  1. Determination of the Coefficient of discharge of given Orifice meter.
  2. Determination of the Coefficient of discharge of given Venturimeter.
  3. Calculation of the rate of flow using Rotameter.
  4. Determination of friction factor for a given set of pipes.
  5. Conducting experiments and drawing the characteristic curves of centrifugal pump
  6. Conducting experiments and drawing the characteristic curves of submergible pump
  7. Conducting experiments and drawing the characteristic curves of reciprocating pump.
  8. Conducting experiments and drawing the characteristic curves of Gear pump.
  9. Conducting experiments and drawing the characteristic curves of Pelton wheel.
 10. Conducting experiments and drawing the characteristics curves of Francis turbine.

• METROLOGY
  1. Calibration of Vernier / Micrometer / Dial gauge
  2. Checking dimensions of part using slip gauges
  3. Measurement of gear tooth dimensions – addendum, dedendum, pitch circle diameter and tooth thickness
  4. Measurement of taper angle using sine bar / tool makers microscope
  5. Measurement of straightness and flatness
  6. Measurement of thread parameters
  7. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical)
  8. Surface finish measurement
COURSE OBJECTIVES

1. To incorporate the concepts and laws in thermodynamic analysis of cyclic processes.
2. To impart the mechanisms of combustion of fuels.
3. To apply the thermodynamic concepts in steam turbines and nozzles.
4. To learn about the performance of compressors.
5. To understand the concept of cogeneration and waste heat recovery in engineering applications.
6. To introduce concepts of refrigeration and air conditioning in engineering applications.

COURSE OUTCOMES

Learners should be able to
1. Calculate the efficiency of various gas power cycles.
2. Calculate the performance characteristics of engines.
3. Analyze combustion mechanisms in I engines.
4. Evaluate the characteristic of steam turbines and nozzles.
5. Evaluate the performance characteristics of compressors.
6. Identify and utilize the concepts of refrigeration and air conditioning in engineering applications.

UNIT I      GAS POWER CYCLES AND IC ENGINES

UNIT II     BOILER AND STEAM POWER CYCLES

UNIT III    STEAM NOZZLES AND STEAM TURBINES
Steam nozzles – flow through steam nozzles, effect of friction, critical pressure ratio, super saturated flow – Steam turbines– impulse and reaction turbine, compounding, velocity diagram, condition for maximum efficiency – multi stage turbines, cycles with reheating and regenerating heating – reheat factor, degree of reaction - governing of turbines.

UNIT IV     AIR COMPRESSORS

UNIT V      REFRIGERATION AND AIR CONDITIONING

(Permitted to use standard thermodynamic table, Mollier diagram, Psychometric chart and Refrigeration property table in the examination)

TOTAL  45+15 = 60 PERIODS

SUGGESTED READINGS
5. Yunus A Cengel, Thermodynamics’ An Engineering Approach, 8e, Tata McGraw Hill, New Delhi, 2015
19PBEME402 DESIGN OF MECHATRONIC SYSTEMS SEMESTER – IV 
3H: 3C

Instruction Hours / Week: - L: 3  T: 0  P: 0  Marks: - Internal: 40  External: 60  Total: 100  End Semester Exam:  3 Hours

COURSE OBJECTIVES
1. To introduce the concepts of sensors and transducers.
2. To familiarize the students to understand the actuation systems.
3. To understand the importance of architecture of microprocessors.
4. To Study and acquire knowledge of the PLC program using ladder logic.
5. To introduce the concepts of design mechatronic system.
6. To provide an overview of develop the controller model for electrical, mechanical and thermal systems

COURSE OUTCOMES
1. Implement the concepts of sensors and transducers.
2. Design the actuation systems.
3. Understand the architecture of microprocessors.
4. Create the PLC program using ladder logic.
5. Design mechatronic system.

UNIT I MECHATRONICS SENSORS AND TRANSDUCERS

UNIT II ACTUATORS AND SYSTEM MODELS
Introduction to system models – Building block of Mechanical, Electrical, Fluid and Thermal Systems.

UNIT III MICROPROCESSORS IN MECHATRONICS

UNIT IV CONTROLLERS

UNIT DESIGN OF MECHATRONIC SYSTEMS

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES

1. To understand the various types of stresses induced in different machine members.
2. To Study and acquire knowledge on design shaft and couplings for effective transmission of power.
3. To study the features of welded joints and fasteners required for various industrial applications.
4. To give exposure to design springs and flywheels for various engineering applications.
5. To understand the importance design bearings and levers for engineering applications.
6. To make the students conversant to implement design procedure for designing a machine.

COURSE OUTCOMES

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

1. Determine various types of stresses induced in different machine members.
2. Design shaft and couplings for effective transmission of power.
3. Select the type of welded joints and fasteners required for various industrial applications.
4. Design springs and flywheels for various engineering applications.
5. Design bearings and levers for engineering applications.
6. Implement design procedure for designing a machine.

UNIT I  STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS


UNIT II  DESIGN OF SHAFTS AND COUPLINGS

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways – Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings – design of knuckle joints.

UNIT III  DESIGN OF FASTENERS AND WELDED JOINTS


UNIT IV  DESIGN OF SPRINGS AND FLYWHEEL

Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs – Belleville springs – Design of flywheels involving stresses in rim and arm.

UNIT V  DESIGN OF BEARINGS AND LEVERS

Selection of bearings – sliding contact and rolling contact types – Cubic mean load – Selection of journal bearings – McKees equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of Levers.

TOTAL  45 PERIODS

SUGGESTED READINGS


Karpagam Academy of Higher Education (Deemed to be University), Coimbatore-641 021.
19PBEME404 ENVIRONMENTAL SCIENCE SEMESTER – IV
3H: 3C

Instruction Hours / Week: - L: 3 T: 0 P: 0 Marks: - Internal: 40 External: 60 Total: 100
End Semester Exam: 3 Hours

COURSE OBJECTIVES
1. To create the awareness about environmental problems among people.
2. To develop an attitude of concern for the environment.
3. To motivate public to participate in environment protection and improvement.
4. To demonstrate proficiency in quantitative methods, qualitative analysis, and critical thinking.
5. To develop writing and oral communication needed to conduct high-level work as interdisciplinary scholars and / or practitioners.
6. To Learn about the systems concepts and methodologies to analyze and understand interactions.

COURSE OUTCOMES
1. Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
2. Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
3. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
4. Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.
5. Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes.
6. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9
Definition, Scope and Importance – Need for public awareness -Forest resources: Use and over-exploitation, deforestation-Water resources-Use and over-utilization of surface and ground water, floods, drought, conflicts over water- Land resources-Land as a resource, land degradation, man induced landslides, soil erosion and desertification –Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources- Food resources-World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture- Energy resources-Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources- role of an individual in conservation of natural resources.

UNIT II ECOSYSTEM 9
Chemistry and Environment- Environmental segments, Composition and Structure of atmosphere- Concept of an ecosystem- Structure, components and function of an ecosystem Energy flow in the ecosystem –Food chain, food web and ecological pyramids, Structure and function of Terrestrial ecosystem (Forest, Desert and Grassland ecosystem) and Aquatic ecosystem (Fresh water and Marine ecosystem)

UNIT III BIODIVERSITY 9
Introduction to biodiversity, Definition- Genetic diversity, Species diversity and Ecosystem diversity, Biogeographical classification of India, Importance of biodiversity-Value of biodiversity - Hot Spots of biodiversity-Threats to biodiversity - Endangered and Endemic Species of India – Conservation of biodiversity- In-Situ and Ex-Situ conservation of biodiversity.

UNIT IV ENVIRONMENTAL POLLUTION 9
Definition – Causes, effects and control Measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution and Thermal pollution. Solid waste management.-Causes, effects and control measures of urban and industrial wastes- Role of an individual in prevention of pollution-Disaster management:-earthquake, tsunami, cyclone and landslides.

UNIT V SOCIAL ISSUES AND ENVIRONMENT 9
From unsustainable to Sustainable development,Urban problems related to energy sources, water conservation, Rain water harvesting and watershed management, Resettlement and rehabilitation of people, its problems and concerns, Environmental ethics- Issues and possible solutions- Climate change- Green house effect and global warming, acid rain, ozone layer depletion, Wasteland reclamation- Environment Protection Act- Human Rights-Value Education, Role of
Information Technology in Environment and human health-Population growth, variation of population among nations-Population explosion.

SUGGESTED READINGS

TOTAL 45 PERIODS
COURSE OBJECTIVES
1. To provide an overview of performance of four stroke single cylinder CI engine.
2. To provide an overview of performance of steam generator and steam turbines.
3. To impart knowledge on thermal conductivity of various engineering materials.
4. To acquaint the student with the concepts of heat transfer rate in free and forced convection environment.
5. To Study and acquire knowledge of grey surface.
6. To study the features of Stefan–Boltzmann constant.

COURSE OUTCOMES
1. Sketch the valve timing diagram for four stroke diesel engine and petrol engines.
2. Evaluate the performance of four stroke single cylinder CI engine.
3. Measure the flash and fire point of various fuel/lubricants.
4. Measure heat transfer rate in free and forced convection environment
5. Determine the grey surface and Stefan–Boltzmann constant
6. Measure the effectiveness of parallel and counter flow heat exchanger.

LIST OF EXPERIMENTS
I C ENGINES AND FUELS
2. Performance Test on 4–stroke Diesel Engine.
4. Retardation Test to find Frictional Power of a Diesel Engine.
6. Determination of Flash Point and Fire Point.

HEAT TRANSFER
1. Heat transfer through a composite wall
2. Thermal conductivity measurement by guarded plate method
3. Natural convection heat transfer from a vertical cylinder
4. Heat transfer from pin–fin (natural and forced convection modes)
5. Effectiveness of Parallel/counter flow heat exchanger
6. Determination of Stefan–Boltzmann constant
7. Determination of emissivity of a grey surface

TOTAL 45 PERIODS
COURSE OBJECTIVES
1. To Study and acquire knowledge on heat transfer for conduction.
2. To introduce the concepts of heat transfer coefficients for natural and forced convection for different fluid flows.
3. To understand the performance of heat exchanger.
4. To study the features of radiation heat transfer between the surfaces.
5. To give exposure to mass transfer.
6. To make the students conversant to solve complex problems where heat and mass transfer takes place.

COURSE OUTCOMES
1. Determine the rate of heat transfer for conduction.
2. Evaluate heat transfer coefficients for natural and forced convection for different fluid flows.
4. Estimate the radiation heat transfer between the surfaces.
5. Calculate the coefficient of mass transfer.
6. Solve complex problems where heat and mass transfer takes place.

UNIT I CONDUCTION

UNIT II CONVECTION

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS

UNIT IV RADIATION

UNIT V MASS TRANSFER

TOTAL 45 + 15 = 60 PERIODS

(Permitted to use standard Heat and Mass Transfer Table in the examination)

SUGGESTED READINGS
COURSE OBJECTIVES
1. To Formulate and solve engineering and managerial situations as LPP.
2. To understand engineering and Managerial situations in Transportation.
3. To Study and acquire knowledge on engineering and Managerial solutions in Assignment and scheduling problems.
4. To give exposure to inventory in industry.
5. To make the student acquire sound knowledge on sequences to perform operation among various alternatives.
6. To provide an overview of various tools in various sections of industries like marketing, material handling etc.

COURSE OUTCOMES
At the end of the course, student will be able to understand the
1. Formulate and solve engineering and managerial situations as LPP.
2. Solve Engineering and Managerial situations in Transportation.
3. Give Engineering and Managerial solutions in Assignment and scheduling problems.
4. Manage inventory in industry.
5. Select better sequence to perform operation among various alternatives.
6. Apply the various tools in various sections of industries like marketing, material handling etc.

UNIT I INTRODUCTION TO OPERATIONS RESEARCH

UNIT II TRANSPORTATION PROBLEMS
Least cost method, North west corner rule, Vogel’s approximation method, modified distribution method, optimization models, unbalance and degeneracy in transportation model.

UNIT III ASSIGNMENT MODELS AND SCHEDULING
Assignment models - Hungarian algorithm, unbalanced assignment problems - maximization case in assignment problems, traveling salesman problem. Scheduling – processing n jobs through two machines, processing n jobs through three machines, processing two jobs through ‘m’ machines, processing n jobs through m machines.

UNIT IV INVENTORY CONTROL AND QUEUING THEORY
Variables in inventory problems, inventory models with penalty, shortage and quantity discount, safety stock, multi item deterministic model.
Queuing Models: Queues – Notation of queues, performance measures, The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns.

UNIT V PROJECT MANAGEMENT, GAME THEORY, REPLACEMENT MODELS
Basic terminologies, constructing a project network, network computations in CPM and PERT, cost crashing –Replacement Models: Replacement of Items due to deterioration with and without time value of Money, Group replacement policy, Staff replacement

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES

1. To Study and acquire knowledge on design the power transmission components like belts, pulleys, ropes, chains and sprockets.
2. To Study and acquire knowledge on design spurs and parallel axis helical gears.
3. To give exposure to dimensions for bevel and worm gears.
4. To provide an overview of design procedures of gear boxes for industrial applications.
5. To provide an overview of clutches and brakes for engineering applications.
6. To make the student acquire sound knowledge of mechanical system.

COURSE OUTCOMES

Upon completion of this course, the students will able to
1. Design the power transmission components like belts, pulleys, ropes, chains and sprockets.
2. Design spurs and parallel axis helical gears.
3. Estimate the dimensions for bevel and worm gears.
4. Practice the design procedures of gear boxes for industrial applications.
5. Design clutches and brakes for engineering applications.
6. Design a mechanical system.

UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS


UNIT II DESIGN OF SPUR AND HELICAL GEARS


UNIT III DESIGN OF BEVEL AND WORM GEARS

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits – terminology – Thermal capacity, materials – forces and stresses, efficiency, estimating the size of the worm gear pair.

UNIT IV DESIGN OF GEAR BOXES


UNIT V DESIGN OF CLUTCHES AND BRAKES

Design of plate clutches – axial clutches – cone clutches – internal expanding rim clutches – internal and external shoe brakes.

TOTAL 45 PERIODS

(Suggested to use PSG design data book in the examination)

SUGGESTED READINGS

5. 10e, McGraw–Hill International Editions, New Delhi, 2015
19PBEME5E - PROFESSIONAL ELECTIVE - I  SEMESTER – V  3H: 3C

19PBEME511  COMPUTER AIDED MANUFACTURING  LABORATORY  SEMESTER – V  3H: 2C

Instruction Hours / Week:  - L: 0  T: 0  P: 3  Marks:  - Internal: 40  External: 60  Total: 100  End Semester Exam:  3 Hours

COURSE OBJECTIVES
1. To study the features of CNC Machine Tool.
2. To expose students to modern control systems (Fanuc, Siemens etc.)
3. To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre
4. To facilitate the understanding of manufacturing drawings from the models created
5. To understand the importance of CAM, CREO, etc
6. To acquaint the student with the concepts of mat lab for performing various mathematical operations

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

1. use computer and CAD software's for modeling of mechanical components
2. use various options in Solid Works for modeling of given components
3. create assembly of components
4. Understand geometric transformation techniques in CAD.
5. Develop mathematical models to represent curves and surfaces and model engineering components using solid modeling techniques.
6. Develop CNC programs to manufacture industrial components.

COMPUTER AIDED MANUFACTURING (CAM)

1. MANUAL PART PROGRAMMING (Using G and M Codes) in CNC Machine.
2. Part programming for Linear, Circular interpolation, and Contour motions.
3. Part programming using standard canned cycles for Thread cutting, Drilling, Peck drilling, and Boring.
4. NC code generation using software’s like Edge CAM, CREO, etc. CNC Controllers like FANUC, Siemens, and Hiedenhain etc.

TOTAL  45 PERIODS
COURSE OBJECTIVES
1. To enable students to understand the fundamental economic concepts applicable to engineering
2. To learn the techniques of incorporating inflation factor in economic decision making.
3. To understand the measures of national income, the functions of banks and concepts of globalization
4. To apply the concepts of financial management for project appraisal
5. To understand accounting systems and analyze financial statements using ratio analysis
6. To understand financial planning, economic basis for replacement.

COURSE OUTCOMES
1. Evaluate the economic theories, cost concepts and pricing policies.
2. Understand the market structures and integration concepts
3. Understand the measures of national income, the functions of banks and concepts of globalization
4. Apply the concepts of financial management for project appraisal
5. Understand accounting systems and analyze financial statements using ratio analysis
6. Understand the impact of inflation, taxation, depreciation, financial planning, economic basis for replacement, project scheduling, and legal and regulatory issues are introduced and applied to economic investment and project-management problems.

UNIT 1 FUNDAMENTALS OF ENGINEERING ECONOMICS
9

UNIT II COMMERCIAL BANKING
9

UNIT III CAPITAL MARKET
9

UNIT IV FINANCIAL CONCEPTS
9

UNIT V COST ANALYSIS AND BREAK EVEN ANALYSIS
9

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES:
1. To understand the importance of automation in the field of machine tool based manufacturing
2. To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC
3. To understand the basics of product design and the role of manufacturing automation
4. To provide an overview of importance of group technology and FMS
5. To provide knowledge on various inspection technologies to enhance the quality of the system
6. To enrich the understanding of various manufacturing support systems

COURSE OUTCOMES
Upon completion of this course, the students will
1. Understand the basics and need for automation in manufacturing
2. Describe the essential requirement of the computers in design
3. Explain the importance of group technology and FMS
4. Understand the essentiality of quality control.
5. Apply various inspection technologies to enhance the quality of the system.
6. Explain various manufacturing support systems.

UNIT I INTRODUCTION

UNIT II COMPUTER AIDED DESIGN

UNIT III COMPUTER AIDED MANUFACTURING
Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC Adaptive Control

UNIT IV LOW COST AUTOMATION
Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies

UNIT V MODELING AND SIMULATION
Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Case studies & industrial applications

TOTAL 45 PERIODS

SUGGESTED READINGS:
COURSE OBJECTIVES

1. To gain knowledge in sequence of process planning and cost estimation of various products.
2. To introduce the concepts of dimensional and tolerance analysis
3. To expose students to manufacturing drawings
4. To equip them with skills to apply their knowledge in re-dimensioning and tolerance charting
5. To understand the process chart for a given component
6. To Estimate the cost of a given component

COURSE OUTCOMES

Upon completion of this course, the student can able to
1. Apply the various standards and conventions used in a drawing sheet
2. Perform dimensional and tolerance analysis
3. Understand the manufacturing drawings
4. Apply their knowledge in re-dimensioning and tolerance charting
5. Prepare process chart for a given component
6. Estimate the cost of a given component

LIST OF EXPERIMENTS

Simple Analysis using ANSYS Tool
1. Stress analysis of rectangular L bracket
2. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
3. Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
4. Harmonic analysis of a 2D component
5. Thermal stress analysis of a 2D component
6. Modeling a 3D component. (Single point cutting tool, I beams, etc.)

TOTAL 45 PERIODS
COURSE OBJECTIVE

1. To introduce the concepts of essentiality of quality.
2. To understand the importance of various TQM principles.
3. To introduce the concepts of the various TQM principles.
4. To understand the techniques for quality management.
5. To introduce the standard quality systems in industries.
6. To familiarize the students to understand the various techniques to improve the quality in industries

COURSE OUTCOMES

1. Understand the essentiality of quality.
2. Summarize various TQM principles.
3. Understand the various TQM principles.
4. Understand the techniques for quality management.
5. Implement standard quality systems in industries.
6. Apply various techniques to improve the quality in industries.

UNIT I ESSENTIALS OF TQM
Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT II TQM PRINCIPLES

UNIT III TQM TOOLS
The new seven management tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma – APQP.

UNIT IV TQM TECHNIQUES

UNIT V QUALITY AND ENVIRONMENT SYSTEMS

TOTAL 45 PERIODS

SUGGESTED READINGS
1. Dale H. Besterfield, Total Quality Management, 4e, Pearson Education, Delhi, 2015
19PBEME7E- PROFESSIONAL ELECTIVE – IV SEMESTER – VII 3H: 3C

19PBEME7E- PROFESSIONAL ELECTIVE - V SEMESTER – VII 3H: 3C

19PBEME791 PROJECT WORK AND VIVA VOCE SEMESTER – VII 9H: 6C

Instruction Hours / Week: - L: 0 T: 0 P: 9 Marks: - Internal: 40 External: 60 Total: 100

COURSE OBJECTIVES
1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE DESCRIPTION
The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL 135 PERIODS
### PROFESSIONAL ELECTIVES

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**Instruction Hours / Week:**  L: 3  T: 0  P: 0  Marks: - Internal: 40  External: 60  Total: 100  
End Semester Exam: 3 Hours

**COURSE OBJECTIVES**

1. To describe various processing techniques of different engineering materials.
2. To analyse the Phase diagram and Microstructure using Microscope for different type of Stainless-steel materials.
3. To describe the metallurgical aspects of aluminium, magnesium and titanium alloys.
4. To get basic knowledge on super alloys and its applications.
5. To get basic understanding of nano materials, shape memory alloys and biomaterials.
6. To select the material for Biological, Nuclear, Space and Cryogenic service applications.

**COURSE OUTCOMES**

Upon completion of this course, the students can

1. Describe various processing techniques of different engineering materials.
2. Analyse the Phase diagram and Microstructure using Microscope for different type of Stainless-steel materials.
3. Describe the metallurgical aspects of aluminium, magnesium and titanium alloys.
4. Get basic knowledge on super alloys and its applications.
5. Get basic understanding of nano materials, shape memory alloys and biomaterials.
6. Select the material for Biological, Nuclear, Space and Cryogenic service applications.

7. **UNIT I**

Techniques of rapid solidification. Production of metallic glasses, atomic arrangement, comparison with crystalline alloys - mechanical, electrical, magnetic, superconducting and chemical properties and applications

8. **UNIT II**

Phase diagrams of ferritic, martensitic and austenitic stainless steels, duplex stainless steels, precipitation hardenable stainless steels, mechanical and metallurgical properties of stainless steels, HSLA steels, micro-alloyed steels

9. **UNIT III**

Aluminium alloys, magnesium alloys and titanium alloys; metallurgical aspects, mechanical properties and applications

10. **UNIT IV**

Development of super alloys-iron base, nickel base and cobalt base - properties and their applications; materials for cryogenic service, materials in nuclear field, materials used in space

11. **UNIT V**

Carbonaceous materials - including nano tubes and fullerenes; shape memory alloys, functionally gradient materials, high temperature super conductors - bio materials

**TOTAL** 45 PERIODS

**SUGGESTED READINGS**

COURSE OBJECTIVES
1. To explain importance of renewable energy resources.
2. To understand the importance of basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
3. To understand the importance of principles of energy conversion from alternate sources.
4. To understand the importance of wind, geothermal, ocean, biomass, biogas and hydrogen.
5. To study the features of design principles of biogas plants.
6. To understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
To give exposure to power plants working with non-conventional energy.

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Understand the importance of renewable energy resources.
2. Understand the basic concepts of solar radiation and analyze the working of solar PV and thermal systems.
3. Understand principles of energy conversion from alternate sources.
4. Understand the importance of wind, geothermal, ocean, biomass, biogas and hydrogen.
5. Implement design principles of biogas plants.
6. Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.

UNIT I ENERGY AND ENVIRONMENT
Primary energy sources – world energy resources–Indian energy scenario–energy cycle of the earth–environmental aspects of energy utilisation, CO₂ emissions and Global warming–renewable energy resources and their importance. Potential impacts of harnessing the different renewable energy resources.

UNIT II SOLAR ENERGY

UNIT III WIND, TIDAL AND GEO THERMAL ENERGY
Energy from the wind – general theory of windmills – types of windmills – design aspects of horizontal axis windmills – applications. Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants – power from geothermal energy – principle of working of geothermal power plants.

UNIT IV BIO ENERGY

UNIT V OTHER RENEWABLE ENERGY SOURCES
Direct energy conversion (Description, principle of working and basic design aspects only) – Magneto hydrodynamic systems (MHD) – thermoelectric generators – thermionic generators – fuel cells – solar cells – types, Emf generated, power output, losses and efficiency and applications. Hydrogen conversion and storage systems

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To understand the underlying principles of operation of different IC Engines and components.
2. To provide knowledge on pollutant formation, control, alternate fueled.
3. To Study and acquire knowledge to Identify parts, terminology and fuel supply system of internal combustion engine
4. To introduce the concepts of cooling and lubrication systems of IC engines
5. To make the student acquire sound knowledge on combustion, knocking and super charging of internal combustion engines
6. To expose students to recent trends associated with IC engines

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Explain the construction and operation of internal combustion engine.
2. Identify parts, terminology and fuel supply system of internal combustion engine.
3. Recognize the component used in cooling and lubrication systems of IC engines.
4. Describe the function of combustion, knocking and super charging of internal combustion engines.
5. Implement strategies for pollution control.
6. Know about the recent trends associated with IC engines

UNIT I SPARK IGNITION ENGINES

UNIT II COMPRESSION IGNITION ENGINES

UNIT III POLLUTANT FORMATION AND CONTROL

UNIT IV ALTERNATIVE FUELS
Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

UNIT V RECENT TRENDS

TOTAL 45 PERIODS

SUGGESTED READINGS
19PBEME5E04  HYDRAULICS AND PNEUMATICS POWER CONTROL  

SEMESTER - V

Instruction Hours / Week:  L: 3  T: 0  P: 0

Marks:  Internal: 40  External: 60  Total: 100

End Semester Exam:  3 Hours

COURSE OBJECTIVES
1. To recognize symbols and fundamentals in fluid power generation and distribution.
2. To identify power source for hydraulic systems.
3. To select appropriate components used in various hydraulic systems.
4. To design hydraulic circuits for given applications.
5. To distinguish the components used in pneumatic circuits.
6. To create the logic circuits for controlling electro-hydraulic/ pneumatic systems.

COURSE OUTCOMES
At the end of the course, the students will be able to
1. Recognize symbols and fundamentals in fluid power generation and distribution.
2. Identify power source for hydraulic systems.
3. Select appropriate components used in various hydraulic systems.
4. Design hydraulic circuits for given applications.
5. Distinguish the components used in pneumatic circuits.
6. Create the logic circuits for controlling electro-hydraulic/ pneumatic systems.

UNIT I  FLUID POWER SYSTEMS AND FUNDAMENTALS

UNIT II  HYDRAULIC SYSTEM AND COMPONENTS

UNIT III  DESIGN OF HYDRAULIC CIRCUITS

UNIT IV  PNEUMATIC SYSTEMS AND COMPONENTS

UNIT V  DESIGN OF PNEUMATIC CIRCUITS
Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

TOTAL 45 PERIODS

SUGGESTED READINGS
4. Anthony Lal, Oil hydraulics in the service of industry, Allied publishers, New Delhi, 1982
INSTRUCTION HOURS / WEEK: L: 3  T: 0  P: 0

COURSE OBJECTIVES
1. To make the student acquire sound knowledge on the types of vehicle structures, cooling and lubrication systems required.
2. To acquaint the student with the concepts of type of engines to be used for modern automobiles.
3. To familiarize the students to Distinguish between the manual transmissions systems with automatic transmission systems.
4. To provide knowledge on appropriate transmission systems for the optimal power transmission.
5. To provide knowledge on steering, brakes and suspension systems for effective functioning.
6. To acquaint the student with advanced technologies in automotive Engineering.

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Identify the types of vehicle structures, cooling and lubrication systems required.
2. Determine the type of engines to be used for modern automobiles.
3. Distinguish between the manual transmissions systems with automatic transmission systems.
4. Select appropriate transmission systems for the optimal power transmission.
5. Select steering, brakes and suspension systems for effective functioning.
6. Implement the advanced technologies in automotive.

UNIT I  AUTOMOBILE ARCHITECTURE AND PERFORMANCE
Automotive components, subsystems and their positions- Chassis, frame and body, front, rear and four wheel drives, Operation and performance, Traction force and traction resistance, Power required for automobile-Rolling, air and gradient resistance.

UNIT II  TYPES OF ENGINE
Types of engine, multi valve engine, in-line engine, vee-engine, Petrol engine-direct, single point and multipoint injection, diesel engine-common rail diesel injection, supercharging and turbo charging, alternate fuels-ethanol and ethanol blend, compressed natural gas, fuel cells, hybrid vehicles.

UNIT III  TRANSMISSION SYSTEMS
Clutch : Types-coil spring and diaphragm type clutch, single and multi plate clutch, centrifugal clutch, Gear box : Types-constant mesh, sliding mesh and synchronesh gear box, layout of gear box, gear selector and shifting mechanism, overdrive, automatic transmission, Propeller shaft, universal joint, slip joint, differential and real axle arrangement, hydraulic coupling.

UNIT IV  WHEEL AND TYRES AND SUSPENSION SYSTEM
Types of wheels, construction, wired wheels, Tyres- construction, Radial, bias & belted bias, slip angle, Tread patterns, Tyre retreading cold & hot, Tubeless tyres
Types-front and rear suspension, conventional and independent type suspension, leaf springs, coil springs, dampers, torsion bars, stabilizer bars, arms, air suspension systems– Balancing of Wheels

UNIT V  STEERING SYSTEM AND BRAKING SYSTEM
Types of steering systems, Ackermann principle, Davis steering gear, steering gear boxes, steering linkages, power steering, wheel geometry-caster, camber toe-in, toe out etc., wheel Alignment and balancing.
Breaking System - Forces on vehicles, tyre grip, load transfer, braking distribution between axles, stopping distance, Types of brakes, Mechanical, Hydraulic, Air brakes, Disc & Drum brakes, Engine brakes anti lock braking system.

TOTAL  45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To impart knowledge on the principles of locating and clamping devices in machining process.
2. To familiarize the students to understand design of jigs for a given component.
3. To Study and acquire knowledge on design fixtures for a given component.
4. To make the student acquire sound knowledge on appropriate type of press tool for a given component.
5. To expose students to drawing die for a given component.
6. To give exposure to the use computer aids for sheet metal forming analysis

COURSE OUTCOMES
Upon the completion of this course the students will be able to
1. Summarize the principles of locating and clamping devices in machining process.
2. Design jigs for a given component.
3. Design fixtures for a given component.
4. Design an appropriate type of press tool for a given component.
5. Develop a drawing die for a given component.
6. Use computer aids for sheet metal forming analysis

UNIT I PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES 9

UNIT II JIGS 9

UNIT III FIXTURES 9
General principles of boring, lathe, milling and broaching fixtures– Grinding, planning and shaping fixtures, assembly, Inspection and welding fixtures– Modular fixtures. Design and development of fixtures for given component.

UNIT IV PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAY OUT 9

UNIT V DESIGN AND DEVELOPMENT OF DIES 9

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
2. To provide knowledge on design aspects of Refrigeration & Air conditioning systems
3. To introduce the concepts on use of unconventional refrigerant system for industrial application
4. To expose students to properties of air using psychrometric chart
5. To provide knowledge on cooling load for a given system
6. To know the application of air conditioning system for industrial and domestic purpose

COURSE OUTCOMES
Learners should be able to
1. Calculate COP of various refrigeration cycles.
2. Choose appropriate refrigerants for various applications.
3. Identify the use of unconventional refrigerant system for industrial application.
4. Calculate the properties of air using psychrometric chart.
5. Calculate cooling load for a given system
6. Select the appropriate air conditioning system for industrial and domestic applications.

UNIT I REFRIGERATION CYCLE

UNIT II REFRIGERANTS, SYSTEM COMPONENTS AND BALANCING

UNIT III PSYCHROMETRY
Psychrometric processes– use of psychrometric charts – – Grand and Room Sensible Heat Factors – bypass factor – requirements of comfort air conditioning – comfort charts – factors governing optimum effective temperature, recommended design conditions and ventilation standards

UNIT IV COOLING LOAD CALCULATIONS

UNIT V AIRCONDITIONING

SUGGESTED READINGS
1. Manohar Prasad, Refrigeration and Air Conditioning, New Age International Ltd, New Delhi, 2011
5. Stoecker N.F and Jerold W.Jones, Refrigeration and Air Conditioning, McGraw Hill, New Delhi, 1986
COURSE OBJECTIVES

1. To provide knowledge on different aspects of powder metallurgy parameters.
2. To understand the importance of principle of advanced welding processes and its application.
3. To understand the importance of advanced forming processes and its application.
4. To familiarize the students to advanced manufacturing process for processing of different materials.
5. To acquaint the student to apply the suitable rapid prototyping mechanism for industry need.
6. To provide knowledge on optimum parametric for advanced manufacturing process.

COURSE OUTCOMES

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

1. Understand different aspects of powder metallurgy parameters.
2. Understand basic principle of advanced welding processes and its application.
3. Understand basic principle of advanced forming processes and its application.
4. Select the best suitable advanced manufacturing process for processing of different materials.
5. Apply the suitable rapid prototyping mechanism for industry need.
6. Select the optimum parametric for advanced manufacturing process.

UNIT I  POWDER METALLURGY PROCESS

UNIT II  ADVANCED WELDING PROCESSES

UNIT III  SHEET METAL AND FORMING PROCESS

UNIT IV  ADVANCED MACHINING PROCESS
Modern machining process: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, Electro chemical Machining, Electro chemical Grinding, Electro Discharge Machining, wire cut EDM, Electron Beam Machining, plasma arc machining, Laser Beam Machining. Ultrasonic Machining, High speed machining process – deep hole drilling process.

UNIT V  RAPID PROTOTYPING

SUGGESTED READINGS

COURSE OBJECTIVES

1. To provide foundations on design of experiments and statistical analysis of experimental data obtained from laboratory and/or industrial processes.
2. To understand the important concepts of single factorial designs.
3. To Study and acquire knowledge on various methodologies involved in single factorial designs.
4. To know the application of testing of factorial experiment.
5. To enrich the understanding of special experimental designs.
6. To impart knowledge on basic concepts of Taguchi method in parameter design.

COURSE OUTCOMES

Upon successful completion of the course, students will be able to:
1. Understand the knowledge of various techniques for experimental planning.
2. Understand the concepts of single factorial designs.
3. List the various methodologies involved in single factorial designs.
4. Apply the concept of testing of factorial experiment.
5. Solve the partial and ordinary differential equations special experimental designs.
6. Apply the basic concepts of Taguchi method in parameter design.

UNIT I INTRODUCTION

UNIT II SINGLE FACTOR EXPERIMENTS
ANOVA rationale - Sum of squares – Completely randomized design, Randomized block design, effect of coding, Comparison of treatment means – Newman Kuel’s test, Duncan’s Multiple Range test, Latin Square Design, Graeco-Latin Square Design, Balanced incomplete design.

UNIT III FACTORIAL EXPERIMENTS
Main and interaction effects – Two and three Factor full factorial Designs, 2^k designs with Two and Three factors- Unreplicated design- Yate’s Algorithm.

UNIT IV SPECIAL EXPERIMENTAL DESIGNS
Blocking in factorial design, Confounding of 2k design, nested design-Response Surface Methods.

UNIT V TAGUCHI TECHNIQUES
Fundamentals of Taguchi methods, Quality Loss function, orthogonal designs, application to Process and Parameter design.

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cell vehicles.
2. To understand working of different configurations of electric vehicles, and its components, hybrid vehicle configuration and performance analysis.
3. To impart knowledge on various energy source
4. To provide knowledge on concepts of electric propulsion systems
5. To expose students to various drive trains for hybrid electric vehicles
6. To facilitate the understanding of the concepts of electronic converters

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Understand the concepts of electric and hybrid electric vehicles
2. Describe about the various energy source available for the hybrid electric vehicles.
3. Explain the concepts of electric propulsion systems
4. Design series drive train for hybrid electric vehicles
5. Design parallel drive train for hybrid electric vehicles
6. Understand the concepts of electronic converters for battery charging of electric hybrid vehicles

UNIT I ELECTRIC AND HYBRID ELECTRIC VEHICLES
Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains

UNIT II ENERGY STORAGE FOR EV AND HEV
Energy storage requirements, Battery parameters, Types of Batteries, Modeling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, PEMFC and its operation, Modeling of PEMFC, Super Capacitors.

UNIT III ELECTRIC PROPULSION
EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives

UNIT IV DESIGN OF ELECTRIC AND HYBRID ELECTRIC VEHICLES
Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine/generator, design of PPS Parallel Hybrid Electric Drive Train Design: Control strategies of parallel hybrid drive train, design of engine power capacity, design of electric motor drive capacity, transmission design, energy storage design

UNIT V POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING
Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Z-converter for battery charging, High frequency transformer based isolated charger topology, Transformer less topology.

TOTAL 45 PERIODS

SUGGESTED READINGS
2. Iqbal Husain Electric and Hybrid Vehicles: Design Fundamentals CRC Press 2010
COURSE OBJECTIVES

1. To understand the importance of the DFM approach and guidelines
2. To enrich the understanding of the selective assembly and Datum systems
3. To introduce the concepts of demonstrate true Position tolerancing theory.
4. To develop an understanding of the standard techniques and redesigning cast members using weldments and plastic component manufacturing.
5. To equip them with skills on Tolerance Charting Technique.
6. To Study and acquire knowledge of the various factors influencing the manufacturability of components and the use of tolerances in manufacturing

COURSE OUTCOMES

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

1. Understand the DFM approach and guidelines
2. Understand the selective assembly and Datum systems
3. Demonstrate true Position tolerancing theory.
4. Understand redesigning cast members using weldments and plastic component manufacturing.
5. Demonstrate the Tolerance Charting Technique.
6. Know the various factors influencing the manufacturability of components and the use of tolerances in manufacturing

UNIT I  DFM APPROACH, SELECTION AND SUBSTITUTION OF MATERIALS IN INDUSTRY

DFM approach, DFM guidelines, standardisation, group technology, value engineering, comparison of materials on cost basis, design for assembly, DFA index, Poka – Yoke principle; $6\sigma$ concept; Tolerance Analysis: Process capability, process capability metrics, $C_p$, $C_{pk}$, cost aspects, feature tolerances, geometric tolerances, surface finish, review of relationship between attainable tolerance grades and different machining process, cumulative effect of tolerances, sure fit law, normal law and truncated normal law.

UNIT II  SELECTIVE ASSEMBLY

Interchangeable and selective assembly, deciding the number of groups, Model–I: group tolerances of mating parts equal; Model–II: total and group tolerances of shaft, control of axial play.
Datum Systems: Grouped datum systems–different types, two and three mutually perpendicular grouped datum planes, grouped datum system with spigot and recess, pin and hole, and tongue–slot pair, computation of translational and rotational accuracy.

UNIT III  TRUE POSITION TOLERANCING THEORY

Comparison between co–ordinate and convention method of feature location tolerancing and true position tolerancing, zero true position tolerance, virtual size concept, floating and fixed fasteners, projected tolerance zone, functional gauges, paper layout gauging, compound assembly, examples.

UNIT IV  FORM DESIGN OF CASTINGS AND WELDMENTS

Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols – design considerations for plastic component manufacturing.

UNIT V  TOLERANCE CHARTING

Tolerance Charting Technique: Operation sequence for typical shaft type of components, preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples, design features to facilitate machining. Datum features – functional and manufacturing, component design–maching considerations, redesign for manufacture, examples.

SUGGESTED READINGS


TOTAL  45 PERIODS
COURSE OBJECTIVES

1. To introduce Governing Equations of viscous fluidflows
2. To introduce numerical modeling and its role in the field of fluid flow and heat transfer
3. To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
4. To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.
5. To equip them with skills to solve convection and diffusion problems.
6. To understand the importance of continuity and momentum equations for different types of fluid flow.

COURSE OUTCOMES

Upon completion of this course, the students can able
1. Identify, solve engineering problems by computational fluid dynamics.
2. Understand the importance of governing equations involved in CFD.
3. Formulate and solve problems in the field of fluid flow and heat transfer.
4. Solve the heat conduction problems using finite difference methods.
5. Analyze and provide solutions for convection and diffusion problems.
6. Develop continuity and momentum equations for different types of fluid flow.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS

UNIT II DISCRETIZATION AND SOLUTION METHODOLOGIES
Solution methodologies: Direct and iterative methods, Thomas algorithm, Relaxation method, Alternating Direction Implicit method.

UNIT III HEAT CONDUCTION
Finite difference and finite volume formulation of steady/transient one-dimensional conduction equation, Source term linearization, Incorporating boundary conditions, Finite volume formulations for two and three dimensional conduction problems.

UNIT IV CONVECTION AND DIFFUSION
Finite volume formulation of steady one-dimensional convection and Diffusion problems, Central, upwind, hybrid and power–law schemes – Discretization equations for two dimensional convection and diffusion.

UNIT V CALCULATION OF FLOW FIELD

TOTAL 45 PERIODS

SUGGESTED READINGS
5. BoseT.K. Jain, Numerical Fluid Dynamics, Narosa publishing House, New Delhi, 2005
19PBEME6E08  POWER PLANT ENGINEERING  SEMESTER - VI

Instruction Hours / Week: - L: 3  T: 0  P: 0  Marks: - Internal: 40  External: 60  Total: 100

End Semester Exam:  3 Hours

COURSE OBJECTIVES
1. To give exposure to accessories and layout required for a steam power plant depending upon the requirements.
2. To study performance of steam power plant.
3. To make the student acquire sound knowledge of working of nuclear and hydel power plant.
4. To study the features of gas turbine power plant.
5. To make the student acquire sound knowledge of economics of the power plant.
6. To make the student acquire sound knowledge on renewable energy technologies and availability.

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Select the accessories and layout required for a steam power plant depending upon the requirements.
2. Compute performance of steam power plant.
3. Explain the working of nuclear and hydel power plant.
5. Calculate the economics of the power plant.
6. Apply appropriate type of renewable energy technologies depending upon the application and availability.

UNIT I  INTRODUCTION TO POWER PLANTS AND BOILERS

UNIT II  STEAM POWER PLANT
Layout of Steam Power Plant - Fuel and Ash Handling, Combustion Equipment for burning coal, Mechanical Stokers, Pulveriser, Electrostatic Precipitator, Draught – different types, Surface Condenser Types, Cooling Towers

UNIT III  NUCLEAR AND HYDEL POWER PLANTS

UNIT IV  DIESEL AND GAS TURBINE POWER PLANT

UNIT V  OTHER POWER PLANTS AND ECONOMICS OF POWER PLANTS
Cost of Electric Energy – Fixed and operating Costs – Energy Rates – Types of Tariffs – Economics of load sharing, comparison of economics of various power plants.

TOTAL  45 PERIODS

SUGGESTED READINGS
1. Arora S.C and Domkundwar S, A course in Power Plant Engineering, Dhanpatrai Publishers, New Delhi, 2014
4. Morse Frederick T, Power Plant Engineering, Prentice Hall of India, New Delhi, 1998
COURSE OBJECTIVES
1. To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies
2. To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.
3. To introduce process involved in Additive manufacturing technology
4. To understand the importance of knowledge on software’s used in additive manufacturing technology
5. To enrich the understanding of the working of SLS and other techniques
6. To provide an overview of additive manufacturing technology in medical field and bio-stream

COURSE OUTCOMES
On completion of this course, students will be able to
1. Understand the need for additive manufacturing technology
2. Explain the process involved in Additive manufacturing technology
3. Get knowledge on software’s used in additive manufacturing technology
4. Describe the working of SLS and other techniques
5. Apply the additive manufacturing technology in medical field
6. Applications of additive manufacturing technology in bio-stream.

UNIT I INTRODUCTION

UNIT II CAD & REVERSE ENGINEERING

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS
Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS

UNIT V MEDICAL AND BIO-ADDITIVE MANUFACTURING
Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies
2. To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.

COURSE OUTCOMES
On completion of this course, students will learn about
1. Basics of SCM and logistics
2. Understand the need for inventory management
3. Apply the need for value of information in SCM
4. Describe about the various strategic alliances
5. Explain about the various issues in the international SCM

UNIT I  INTRODUCTION TO SUPPLY CHAIN MANAGEMENT
Definition, global optimization, Objectives of SCM. Logistics networks – data collection, model and data elevation, solution techniques.

UNIT II  INVENTORY MANAGEMENT
Introduction, single warehouse, Inventory examples, economic lot size model, effect of demand uncertainty. Risk pooling, centralized and decentralized system, managing inventory in the supply chain, forecasting.

UNIT III  VALUE OF INFORMATION

UNIT IV  STRATEGIC ALLIANCES
Framework for strategic alliance, third party logistics, retailer, supplies partnership, distributor – integration, procurement and out servicing strategies.

UNIT V  INTERNATIONAL ISSUES IN SCM
Introduction, risks and advantages– design for logistics, supplies integration into to new product development, mass customization. Issues in customer value.
Information technology for SCM: Goals, standardization, infrastructure, DSS for supply chain management.

SUGGESTED READINGS
1. To understand the basic difference between incompressible and compressible flow.
2. To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.
3. To introduce the concepts of various conditions of compressible fluid flows
4. To Study and acquire knowledge on performance analysis of subsonic and supersonic inlets, combustors, afterburners and exhaust nozzles
5. To understand the concept of working of various types of rocket engines
6. To study the features of thrust equation for rocket propulsion system

Upon completion of this course, the students can able to
1. Analyze various conditions of compressible fluid flows.
2. Calculate mass flow rate in flow through variable area ducts.
4. Perform performance analysis of combustors, afterburners and exhaust nozzles.
5. Understand the working of various types of rocket engines
6. Use thrust equation for rocket propulsion system.


Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – Variation of flow properties – Isothermal flow with friction in constant area ducts – Use of tables and charts – Generalised gas dynamics.

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Use of table and charts – Applications.


(Permitted to use standard Gas Tables in the examination)

SUGGESTED READINGS
2. Rathakrishnan,E, Gas Dynamics, Prentice Hall of India, New Delhi, 2017
19PBEME7E02 PRODUCTION PLANNING AND CONTROL SEMESTER - VII
3H: 3C

Instruction Hours / Week: - L: 3  T: 0  P: 0  Marks: - Internal: 40  External: 60  Total: 100
End Semester Exam:  3 Hours

COURSE OBJECTIVES
1. To impart knowledge of need for planning and control in various aspects.
2. To develop an understanding of the standard techniques in various work study methodologies.
3. To familiarize the students to understand the product and process plan.
4. To introduce the concepts of a production schedule based on different facets.
5. To enrich the understanding of the level of inventory
6. To understand the importance the recent advancements in production planning and control.

COURSE OUTCOMES
Student will be able to
1. Indicate the need for planning and control in various aspects.
2. Understand various work study methodologies.
3. Construct product and process plan.
4. Prepare a production schedule based on different facets.
5. Estimate the level of inventory
6. Understand the recent advancements in production planning and control.

UNIT I INTRODUCTION 9

UNIT II WORK STUDY 9

UNIT III PRODUCT PLANNING AND PROCESS PLANNING 9

UNIT IV PRODUCTION SCHEDULING 9

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9
Inventory control–Purpose of holding stock–Effect of demand on inventories–Ordering procedures.
Two bin system –Ordering cycle system–Determination of Economic order quantity and economic lot size–ABC analysis–Recorder procedure–Introduction to computer integrated production planning systems–elements of JIT Systems–Fundamentals of MRP and ERP, KANBAN system

TOTAL 45 PERIODS

SUGGESTED READINGS
1. Martand Telsang, Industrial Engineering and Production Management, S.Chand and Company, New Delhi, 2006

19PBEME7E03 MACHINE TOOL DESIGN SEMESTER - VII
Instruction Hours / Week:  
- L: 3  
- T: 0  
- P: 0  

Marks:  
- Internal: 40  
- External: 60  
- Total: 100  

End Semester Exam: 3 Hours

COURSE OBJECTIVE

1. To gain knowledge in design and material selection of various machine tools.  
2. To provide an overview of regulation of speeds and feeds  
3. To study the features of machine tool structures  
4. To understand the importance of constructional features of machine tool structures  
5. To expose students to design in machine tool structures, guide ways, power screws and spindles  
6. To expose students to design spindles and spindle supports

COURSE OUTCOMES:

Upon the completion of this course the students will be able to  
1. Discuss the basics of machine tool drives and mechanisms  
2. Get knowledge on regulation of speeds and feeds  
3. Understand the importance of machine tool structures  
4. Explain the constructional features of machine tool structures  
5. Design in machine tool structures, guide ways, power screws and spindles  
6. Design spindles and spindle supports

UNIT I  INTRODUCTION TO MACHINE TOOL DRIVES AND MECHANISMS  9
Introduction to the course, Working and Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission

UNIT II  REGULATION OF SPEEDS AND FEEDS  9
Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design

UNIT III  DESIGN OF MACHINE TOOL STRUCTURES  9

UNIT IV  DESIGN OF GUIDeways, POWER SCREWS AND SPINDLES  9

UNIT V  DESIGN OF SPINDLES AND SPINDLE SUPPORTS  9

TOTAL  45 PERIODS

SUGGESTED READINGS
2. Chernov N, Machine Tools, Mir publishers Moscow, 1984  
3. N.K. Mehta, Machine Tool Design and Numerical Control, 3e, TMH, New Delhi, 2012  
COURSE OBJECTIVES
1. To understand the application of computers in various aspects of Manufacturing viz., Design, proper planning, Manufacturing cost, Layout & Material Handling system.
2. To know the application of principles of group technology in computer aided process planning.
3. To impart knowledge on working of the shop floor control
4. To Study and acquire knowledge on data collection system in FMS.
5. To familiarize the students to understand CIM architecture for practical application.
6. To expose students to generate database for computer integrated manufacturing processes.

COURSE OUTCOMES
Upon completion of this course, the student can able to
1. Implement computer integrated manufacturing concepts in industries.
2. Apply the principles of group technology in computer aided process planning.
3. Understand the working of the shop floor control
4. Implement automated data collection system in FMS.
5. Develop CIM architecture for practical application.
6. Generate database for computer integrated manufacturing processes

UNIT I INTRODUCTION

UNIT II GROUP TECHNOLOGY
Group technology– part families – Classification and coding – Approaches to computer aided process planning –variant approach and generative approaches

UNIT III SHOP FLOOR CONTROL AND INTRODUCTION OF FMS

UNIT IV CIM IMPLEMENTATION AND DATA COMMUNICATION

UNIT V OPEN SYSTEM AND DATABASE FOR CIM
Open systems–open system inter connection – manufacturing automations protocol and technical office protocol (MAP /TOP).

TOTAL 45 PERIODS

SUGGESTED READINGS
4. Radhakrishnan P and Subramanyan S , CAD/CAM/CIM, 2e, New Age International (P) Ltd, New Delhi, 2011
COURSE OBJECTIVES
1. To enable the students to gain competence in various Welding Technologies and to have in depth understanding of the weld ability of metals.
2. To expose students to Identify suitable reinforcement and matrix materials for preparation of composites using friction stir processing.
3. To understand the basic principle of electron beam and laser beam processes and its application.
4. To understand the weld ability of cast iron and high carbon steel.
5. To provide knowledge on welding power sources.
6. To facilitate the understanding of grain growth mechanism and related properties.

COURSE OUTCOMES
At the end of the course, the student will be able to:
1. Understand solid state welding processes and applications.
2. Identify suitable reinforcement and matrix materials for preparation of composites using friction stir processing.
3. Understand basic principle of electron beam and laser beam processes and its application.
4. Understand weldability of cast iron and high carbon steel.
5. Select welding power sources.
6. Understand the importance of grain growth mechanism and related properties.

UNIT I    SOLID STATE WELDING
Solid state welding: classification of solid state welding processes, Adhesive bonding , advantages and applications.

UNIT II   FRICTION AND FRICTION STIR WELDING
Friction welding: Friction welding process variables, welding of similar and dissimilar materials, Defective analysis of friction welded components, Friction welding of materials with inter layer.
Friction stir welding: Processes parameters, tool geometry, welding of Aluminium alloys, Friction stir welding of Aluminum alloys and Magnesium alloys.

UNIT III  ELECTRON BEAM WELDING

UNIT IV   LASER BEAM WELDING
Laser Beam welding (LBW): Laser Beam welding process parameters, atmospheric affect and Laser Beam welding of steels.

UNIT V    SELECTION POWER SOURCE AND WELDABILITY
Selection power source : Constant voltage and constant current power sources. Weldability of cast iron and steel : weldability studies of cast iron and steel

TOTAL   45 PERIODS

SUGGESTED READINGS
Instruction Hours / Week: L: 3  T: 0  P: 0  Marks: Internal: 40  External: 60  Total: 100

COURSE OBJECTIVES
1. To understand the fundamentals of composite material strength and its mechanical behavior
2. Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
3. Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
4. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.
5. To introduce the concepts of carbon-carbon composite for different industrial application
6. To impart knowledge on various advances in composites

COURSE OUTCOMES
Learners should be able to
1. Select the various types of composite matrix required for an application.
2. Choose appropriate manufacturing process for polymer matrix composite.
4. Use the concepts of ceramic composites and its production techniques.
5. Identify the type of carbon-carbon composite for different industrial application.
6. Explain the various advances in composites

UNIT I  INTRODUCTION TO COMPOSITES

UNIT II  POLYMER MATRIX COMPOSITES

UNIT III  METAL MATRIX COMPOSITES

UNIT IV  CERAMIC MATRIX COMPOSITES

UNIT V  ADVANCES IN COMPOSITES

TOTAL  45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To Understand the concept of SQC.
2. To enrich the understanding of control charts to analyze for improving the process quality.
3. To familiarize the students to understand different sampling plans
4. To Understand the importance of need and types of life testing.
5. To introduce the reliability of a system.
6. To introduce the concepts of quality control and reliability techniques in industries.

COURSE OUTCOMES
Upon the completion of this course the students will be able to
1. Understand the concept of SQC.
2. Use control charts to analyze for improving the process quality.
3. Describe different sampling plans
4. Understand the need and types of life testing.
5. Improve the reliability of a system
6. Implement quality control and reliability techniques in industries

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES
Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality cost–Variation in process– factors – process capability – process capability studies and simple problems – Theory of control chart– uses of control chart – Control chart for variables – X chart, R chart and σ chart.

UNIT II PROCESS CONTROL FOR ATTRIBUTES
Control chart for attributes –control chart for proportion or fraction defectives – P chart and NP chart – control chart for defects – C and U charts, State of control and process out of control identification in charts.

UNIT III ACCEPTANCE SAMPLING

UNIT IV LIFE TESTING – RELIABILITY

UNIT V QUALITY AND RELIABILITY

Note: Permitted to use approved statistical table in the examination.

TOTAL 45 PERIODS

SUGGESTED READINGS
2. Srinath L.S., Reliability Engineering, Affiliated East west press New Delhi, 2002

19PBEME7E08 NON DESTRUCTIVE TESTING SEMESTER - VII
3H: 3C
COURSE OBJECTIVES
1. To provide in-depth knowledge on various techniques of non-destructive testing
2. To provide an overview of destructive and non-destructive tests and state their applications
3. To study the features of NDT techniques for various products.
4. To expose students to skills needed for selection of appropriate NDT technique(s) for new inspection jobs
5. To understand the established NDE techniques and basic familiarity of emerging NDE techniques.
6. To facilitate the understanding of standard application area of NDET

COURSE OUTCOMES
Student will be able to
1. Understand the codes, standards and specifications related to NDT
2. Classify the destructive and non-destructive tests and state their applications
3. Develop NDT techniques for various products.
4. Acquire skills needed for selection of appropriate NDT technique(s) for new inspection jobs
5. Acquire sound knowledge of established NDE techniques and basic familiarity of emerging NDE techniques.
6. Make use of standards application area of NDET

UNIT I INTRODUCTION
Properties of Materials – Characteristics of Ferrous, Non-ferrous and Alloys. Destructive testing and Non-destructive testing – Classification – Uses and applications. Codes, Standards and Specifications (ASME, ASTM, AWS etc.).

UNIT II PENETRANT TESTING AND MAGNETIC PARTICLE INSPECTION
Introduction to Penetrant Testing – Liquid Penetrants and Dye Penetrants - An Illustration of Penetrant Testing, Advantages of Penetrants Testing, Disadvantages of Penetrant Testing. Introduction to Magnetic Particle Inspection - An Illustration of Magnetic Particle Inspection, Advantages of Magnetic Particle Crack Detection, Disadvantages of Magnetic Particle Crack Detection

UNIT III ULTRASONIC FLAW DETECTION AND RADIOGRAPHY INSPECTION

UNIT IV EDDY CURRENT AND ELECTRO-MAGNETIC METHODS

UNIT V NON-DESTRUCTIVE INSPECTION (NDI) AND ITS APPLICATIONS
Inspection of Raw Products, Inspection For In-Service Damage, Power Plant Inspection, Storage Tank Inspection, Aircraft Inspection, Jet Engine Inspection, Pressure Vessel Inspection, Bridge Inspection, Pipeline Inspection.

TOTAL 45 PERIODS

SUGGESTED READINGS
COURSE OBJECTIVES
1. To provide in-depth knowledge on various techniques of non-destructive testing
2. To acquaint the student with the need and awareness of the safety concepts
3. To understand the importance of various safety techniques involved in industrial sector
4. To introduce the concepts of accident zone and prepare reports related to it.
5. To equip them with skills to conduct basic safety inspections using strategies that they have developed
6. To develop an understanding of safety monitoring

COURSE OUTCOMES
At the end of the course, student will be able to
1. Understand the need and awareness of the safety concepts
2. Understand the various safety techniques involved in industrial sector
3. Record and investigate the accident zone and prepare reports related to it.
4. Conduct basic safety inspections using strategies that they have developed
5. Identify and demonstrate working of safety monitoring
6. Train about the education and training based on safety

UNIT I    CONCEPTS
Evolution of modern safety concept - Safety policy - Safety Organization - line and staff functions for safety - Safety Committee- budgeting for safety.

UNIT II    TECHNIQUES
Incident Recall Technique (IRT), disaster control, Job Safety Analysis (JSA), safety survey, safety inspection, safety sampling, Safety Audit.

UNIT III   ACCIDENT INVESTIGATION AND REPORTING
Concept of an accident, reportable and non reportable accidents, unsafe act and condition – principles of accident prevention, Supervisory role- Role of safety committee – Accident causation models - Cost of accident. Overall accident investigation process - Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, functions of investigator, four types of evidences, Records of accidents, accident reports

UNIT IV    SAFETY PERFORMANCE MONITORING
Reactive and proactive monitoring techniques - Permanent total disabilities, permanent partial disabilities, temporary total disabilities -Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.

UNIT V    SAFETY EDUCATION AND TRAINING

TOTAL     45 PERIODS

SUGGESTED READINGS

19PBEME7E10   INDUSTRIAL ROBOTICS   SEMESTER - VII
3H: 3C
COURSE OBJECTIVES
1. To understand the anatomy, basic concepts and applications of robot.
2. To learn the drives and end effectors used in robot.
3. To study the various types of sensors used in robot.
4. To familiarize robot kinematics and robot programming
5. To provide knowledge on simple offline robot program
6. To impart knowledge on economic analysis of robots

COURSE OUTCOMES
Upon completion of this course, the students can able to
1. Identify the various types of robots.
2. Select appropriate drive systems and end effectors for industrial application.
3. Decide the types of sensors required according to the applications of robot.
4. To identify the different types of machine vision technologies
5. Develop simple offline robot program for different applications.
6. Calculate the economic analysis of robots.

UNIT I FUNDAMENTALS OF ROBOT

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives
End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

UNIT III SENSORS AND MACHINE VISION

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING
Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems.
Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS

TOTAL 45 PERIODS

SUGGESTED READINGS