## SEMESTER I

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<tr>
<td>20BEME7E10</td>
<td>Advanced I.C. Engines</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
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<tr>
<td>20BEME7E11</td>
<td>Non-Destructive Testing</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
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<tr>
<td>20BEME7E12</td>
<td>Industrial Safety Engineering</td>
<td>3 L 0 T 0 P</td>
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## PROFESSIONAL ELECTIVE VI

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course title</th>
<th>Instruction Hours / Week</th>
<th>Credits</th>
<th>Maximum Marks</th>
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<tr>
<td>20BEME8E01</td>
<td>Quality Control and Reliability Engineering</td>
<td>3 L 0 T 0 P</td>
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<td>20BEME8E02</td>
<td>Cogeneration and Waste Heat Recovery Systems</td>
<td>3 L 0 T 0 P</td>
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<td>20BEME8E03</td>
<td>Computer Aided Drafting and Cost Estimation</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
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<td>20BEME8E04</td>
<td>Battery Management System</td>
<td>3 L 0 T 0 P</td>
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### COURSES OFFERED BY OTHER DEPARTMENTS

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<td>20BESHOE**</td>
<td>Solid Waste Management</td>
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<td>Green Chemistry</td>
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<td>20BESHOE**</td>
<td>Applied Electrochemistry</td>
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<td>20BEEEOE**</td>
<td>Electric Hybrid Vehicles</td>
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<td>20BEEEOE**</td>
<td>Renewable Energy Resources</td>
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<td>20BECCEO**</td>
<td>Housing, Plan and Management</td>
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<td>20BECCEO**</td>
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<td>20BTCEO**</td>
<td>Industrial Wastewater Treatment</td>
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### COURSES OFFERED TO OTHER DEPARTMENTS

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<tr>
<td>20BEMEOE01</td>
<td>Computer Aided Design</td>
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<tr>
<td>20BEMEOE02</td>
<td>Industrial Safety and Environment</td>
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</table>

- **Skill Development**
- **Employability Skill**
- **Entrepreneurship Skill**

#### Programme Educational Objectives (PEO’s)

- **1**: Graduates will more conscious about their profession with social awareness and responsibility.
- **2**: Graduates will be engineering experts, who would help solve industry's technological problems.
- **3**: Graduates will be engineering professionals, consultants or entrepreneurs engaged in technology development.

#### Programme Outcomes (PO’s)

- **1 - Engineering Knowledge**: Ability to apply knowledge of mathematics, science and engineering fundamentals for solving the complex engineering problems.
2 - **Problem Analysis:** Identify, formulate, review and analyze the complex engineering problems, by conceptual and fundamental principles of mechanical engineering to reach value added sustainable conclusions.

3 - **Designs / development of solution:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, cultural, societal and environmental consideration.

4 - **Conduct investigations of complex Problems:** Ability to apply appropriate tools, technique and research knowledge to investigate complex engineering problems.

5 - **Modern tool usage:** To understand and apply modern techniques and IT tools for the design and analysis of mechanical systems.

6 - **The engineer and society:** Understand the impact of engineering solutions in a societal context and to be able to respond effectively to the needs for sustainable development.

7 - **Environment and sustainability:** Understanding the mechanism of pollutant formation and its control techniques.

8 - **Ethics:** Understanding of human and ethical responsibilities towards the profession and society.

9 - **Individual and team work:** Function effectively as an individual, and as a member or a leader in diverse teams, and in multi-disciplinary situations.

10 - **Communication:** Ability to communicate effectively with engineering community and instruct in the form of reports, presentation and documents.

11 - **Project management and finance:** Ability to understand the economics and cost analysis in order to take economically sound decisions.

12 - **Lifelong learning:** To recognize the need for, and have the ability to engage in independent and lifelong learning.

**Programme Specific Outcomes (PSO’s)**

- **1:** students acquired theoretical and practical background of technical and managerial skill to make them employable graduate.
- **2:** students beamed fundamentally and rural – time (physical) problem solving skills by the use of advanced materials research lab and advanced welding laboratory.

<table>
<thead>
<tr>
<th>Programme Educational Objectives</th>
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</table>
PEO: Programme Educational Objectives  PO: Programme Outcomes
L: Lecture Hour  T: Tutorial Hour  CIA: Continuous Internal Assessment
P: Practical Hour  C: No. of Credits  ESE: End Semester Examinations
Note:
1. The passing minimum for Mandatory course is 50 marks out of 100 marks. There will be two tests, of which one will be class test covering 50% of syllabus for 50 marks and other for 50 marks.
2. Credits for mandatory courses are not counted for computation of CGPA.
3. A student will be eligible to get Under Graduate degree with Honors or additional Minor Engineering, if he/she completes an additional 20 credits. These could be acquired through MOOCs.
COURSE OBJECTIVES

1. To enable students to attain fluency and accuracy to inculcate proficiency in professional communication to meet the growing demand in the field of Global communication.
2. To make the students to meet the growing demand in the field of Global communication.
3. To help students acquire their ability to speak effectively in real life situations.
4. To inculcate the habit of reading and to develop their effective reading skills.
5. To ensure that students use dictionary to improve their active and passive vocabulary.
6. To enable students to improve their lexical, grammatical and communicative competence.

COURSE OUTCOMES

Students undergoing this course will be able to
1. Use English language for communication: verbal & non--verbal.
2. Enrich comprehension and acquisition of speaking & writing ability.
4. Improve word power: lexical, grammatical and communication competence.
5. To guide the students to write business letters and other forms of technical writing.
6. To enable students to prepare for oral communication in formal contexts.

UNIT: I - BASIC WRITING SKILLS
Sentence Structures - Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents - Techniques for writing precisely

UNIT: II - VOCABULARY BUILDING
The concept of Word Formation - Root words from foreign languages and their use in English - Acquaintance, with prefixes and suffixes from foreign languages in English to form derivatives. - Synonyms, antonyms, and standard abbreviations.

UNIT: III - GRAMMAR AND USAGE
Subject-verb agreement - Noun-pronoun agreement - Misplaced modifiers – Articles – Prepositions – Redundancies - Clichés

UNIT: IV - LISTENING AND READING SKILLS
Note taking- viewing model interviews – listening to informal conversations – improving listening / reading comprehension – reading model prose / poems – reading exercise

UNIT: V.-WRITING PRACTICES
Comprehension - Précis Writing - Essay Writing Listening Comprehension - Common Everyday Situations: Conversations and Dialogues - Communication at Workplace – Interviews - Formal Presentations

Note: Students shall have hands on training in improving listening skill in the language laboratory @ 2 periods per each unit.

SUGGESTED READINGS

COURSE OBJECTIVES

The goal of this course is for the students

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2. To understand geometrical aspects of curvature and elegant application of differential calculus which are needed in engineering applications.
3. To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model Engineering problems.
4. To familiarize the student with functions of several variables this is the foundation for many branches of Engineering.
5. To introduce sequence and series this is central to many applications in Engineering.
6. To equip the students with standard concepts and tools at an intermediate to advanced level.

COURSE OUTCOMES

Upon completion of this course the students will be able

1. To solve the rank, Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices and the students will be able to use matrix algebra techniques for practical applications.
2. To equip the students to have basic knowledge and understanding in one field of materials, differential calculus
3. To solve simple standard examples using the ideas of differential equations.
4. To apply various techniques to solve Partial Differential Equations
5. To develop the tool of power series for learning advanced Engineering Mathematics.
6. To apply the knowledge acquired to solve various Engineering problems.

UNIT I - MATRICES


UNIT II – DIFFERENTIAL CALCULUS

Overview of Derivatives - Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes- Evolutes as Envelope of normals

UNIT III - DIFFERENTIAL EQUATIONS

Linear Differential equations of second and higher order with constant coefficients – Homogeneous equation of Euler’s and Legendre’s type – Method of variation parameters.

UNIT IV – FUNCTIONS OF SEVERAL VARIABLES


UNIT V - SEQUENCES AND SERIES

SUGGESTED READINGS:


WEBSITES:

1. www.efunda.com
2. www.mathcentre.ac.uk
3. www.intmath.com/matrices-determinants
(i) THEORY

COURSE OBJECTIVES

The Goal of this course is for students to

1. Inculcate the basics of properties of matter, sound and its applications.
2. Basics of laser and optical fiber with appropriate applications.
3. Disseminate the fundamentals of thermal physics and their applications.
4. Introduce the concepts of quantum mechanics for diverse applications.
5. Impart the basic knowledge of crystal and its various crystal structures.
6. To make the students to understand the process of production and measurement.

COURSE OUTCOMES

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

1. Understand the elastic nature of materials.
2. Infer the characteristics of laser for various engineering applications.
3. Extend the knowledge on optical fiber for communication purposes.
4. Illustrate the thermal properties of materials through various methods.
5. Develop the idea of quantum mechanics through applications.
6. Identify the different atomic arrangements of crystals and its defects.

UNIT I – PROPERTIES OF MATTER AND SOUND


Loudness, decibel, echo, reverberation, Sabine’s formula, Ultrasonic – Production, Industrial and medical applications.

UNIT II – LIGHT, LASER AND FIBER OPTICS


Fiber optics: Total internal reflection – modes of propagation of light in optical fibers – numerical aperture and acceptance angle – types of optical fibers (Material, refractive index and mode) – fiber optical communication system (block diagram) - Fiber optic sensors: pressure and displacement.

UNIT III – THERMAL PHYSICS


UNIT IV – QUANTUM PHYSICS

UNIT V – CRYSTAL PHYSICS

Crystalline materials – types - unit cell, primitive cell, intercepts, interfacial angle - crystal systems, Bravais lattices, Miller indices – determination of inter-planar distances - Coordination number and packing factor for SC, BCC, FCC, HCP structures-crystal imperfections: point defect, line defect, surface and volume defect. Crystal growth techniques:Czochralski and Bridgman method.

SUGGESTED READINGS


JOURNALS

3. Ultrasonics and sonochemistry (Elsevier).
5. Optics and Laser Technology (Elsevier).

WEBLINKS

1. https://nptel.ac.in/courses/122/103/122103011/
2. https://nptel.ac.in/courses/113/104/113104081/
3. http://hyperphysics.phy-astr.gsu.edu/hbase/optmod/latexn.html

(ii) LABORATORY

COURSE OBJECTIVE:

• To learn the basic concepts in physics relevant to different branches of Engineering and Technology.

COURSE OUTCOME:

• To familiarize the properties of material and basic concepts in physics.

LIST OF EXPERIMENTS – PHYSICS (Any 10 Experiments)

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of disc
2. Uniform bending (or) Non-uniform Bending – Determination of young’s modulus.
3. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille’s flow.
4. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids.
5. Laser- Determination of the wave length of the laser using grating, Acceptance angle of optical fiber.
12. Particle size determination using LASER.
(i) CONCEPTS IN CHEMISTRY FOR ENGINEERING

COURSE OBJECTIVE
The goal of this course is for students to
1. Study the basics of Periodic properties, Intermolecular forces
2. Understand the terminologies of electrochemistry and to study about energy storage devices
3. Understand the concept of corrosion and its prevention
4. Comprehend the basic water technology and its purification.
5. Comprehend the basic organic chemistry and to synthesis simple drug.
6. Study about spectroscopic technique.

COURSE OUTCOMES
Upon completion of the course the students will be able to
1. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
2. Analyse the mechanism of different energy storage devices.
3. Rationalise different types of corrosion and its prevention.
4. List the various methods in the purification of water.
5. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I - PERIODIC PROPERTIES, INTERMOLECULAR FORCES
Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers. Ionic, dipolar and van Der Waals interactions.

UNIT II – ELECTROCHEMISTRY AND STORAGE DEVICES
Thermodynamic functions. Free energy and emf. Cell potentials, the Nernst equation and applications. Types of electrodes Standard Hydrogen Electrode (SHE) & Calomel. Energy storage devices Primary and secondary cells leclanche cell, Lead Acid Battery, Nickel Cadmium Battery, Lithium Battery Charging and discarding reactions.

UNIT III – CORROSION AND ITS CONTROL
Chemical and Electrochemical corrosion - Galvanic corrosion - Differential aeration corrosion - Corrosion control - Sacrificial anode and Impressed current cathodic methods - Corrosion inhibitors - Protective coatings – Organic Coatings-Paints - Constituents and functions – Inorganic coatings- Metallic coatings - Electroplating (Au) and Electro less plating (Ni) - Surface conversion coating - Hot dipping

UNIT IV – WATER TECHNOLOGY
Reverse osmosis.

UNIT V - SPECTROSCOPIC TECHNIQUES AND APPLICATIONS


SUGGESTED READINGS

4. B. L. Tembe, Kamaluddin and M. S. Krishnan, Engineering Chemistry (NPTEL Web-book)

(ii) CHEMISTRY LABORATORY

COURSE OBJECTIVES

The goal of this course is for students to

- To provide students with practical knowledge of quantitative analysis of materials by classical and instrumental methods for developing experimental skills in building technical competence.

COURSE OUTCOMES

Upon completion of the course the students will be able to

1. The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
2. Estimate rate constants of reactions from concentration of reactants/products as a function of time
3. Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc

Choice of 10 experiments from the following:
1. Determination of surface tension and viscosity
2. Determination of Sodium Carbonate and Sodium Hydrogen Carbonate in a mixture using volumetric titration
3. Determination of Ca / Mg using complexometric titration
4. Thin layer chromatography
5. Determination of chloride content of water
6. Determination of the rate constant of a reaction
7. Conductometry - Determination of cell constant and conductance of solutions
8. pH Metry – Determination of Acid / Base
9. Potentiometry - determination of redox potentials and emfs
10. Saponification/acid value of an oil
11. Determination of the partition coefficient of a substance between two immiscible liquids
12. Adsorption of acetic acid by charcoal
13. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.
SEMESTER I

20BEME143

PYTHON PROGRAMMING
(Theory & Laboratory) 4 H – 3 C

Instruction hours / week L : 2 T : 0 P: 2

Marks: Internal : 40 External : 60 Total:100
End Semester Exam :3Hours

(i) THEORY

COURSE OBJECTIVES:

Students undergoing this course are exposed to:

1. Describe the core syntax and semantics of Python programming language.
2. Discover the need for working with the strings and functions.
3. Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
4. Indicate the use of regular expressions and built-in functions to navigate the file system.
5. Infer the Object-oriented Programming concepts in Python.
6. Students will solve problems, explore real-world software development challenges, and create practical and contemporary applications.

COURSE OUTCOMES:

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

1. Explain various operators used in python.
2. Apply the string handling functions to solve the given problem
3. Describe Object oriented concepts with python
4. Use image processing techniques in python programming to solve a given problem
5. Discuss the functions of networking in python
6. Solve a given analogy

UNIT I INTRODUCTION

Installing Python; basic syntax, interactive shell, editing, saving, and running a script; variable, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages;

UNIT II CONDITIONAL STATEMENT & STRING HANDLING

Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation – Manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers.

UNIT III OBJECT ORIENTED PROGRAMMING WITH PYTHON

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects – OOP, continued: inheritance, polymorphism, operator overloading; abstract classes; exception handling, try block

UNIT IV IMAGE PROCESSING WITH PYTHON

Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions Simple Graphics and Image Processing: “turtle” module; simple 2d drawing – colors, shapes; digital images, image file formats, image processing Simple image manipulations with ‘image’ module (convert to b/w, rayscale, blur, etc).

UNIT V NETWORKING WITH PYTHON

Multithreading, Networks, and Client/Server Programming; introduction to HTML, interacting with remote HTML server, running html-based queries, downloading pages; CGI programming, programming a simple CGI form.
SUGGESTED READINGS:
5. “Python Cookbook” O’Reilly Media; 3rd edition (June 1, 2013) by David M. Baezly.

WEBSITES:
1. https://www.codecademy.com/learn/python
2. www.learnpython.org/

(ii) LABORATORY

PYTHON PROGRAMMING

COURSE OBJECTIVES:
Students undergoing this course are exposed to:
1. To write, test, and debug simple Python programs.
2. To implement Python programs with conditionals and loops.
3. Use functions for structuring Python programs.
4. To infer the Object-oriented Programming concepts in Python.
5. Represent compound data using Python lists, tuples, and dictionaries.
6. Read and write data from/to files in Python.

COURSE OUTCOMES:
Upon completion of the course, students will be able to:
1. Write, test, and debug simple Python programs.
2. Implement Python programs with conditionals and loops.
3. Develop Python programs step-wise by defining functions and calling them.
4. Infer the Object-oriented Programming concepts in Python.
5. Use Python lists, tuples, dictionaries for representing compound data.
6. Read and write data from/to files in Python.

LIST OF EXPERIMENTS:
1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton’s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball in Pygame
SEMESTER I

20BEME111 ENGINEERING GRAPHICS I 5 H – 3 C

Instruction hours / week L : 1 T : 0 P:4 Marks: Internal : 40 External : 60 Total:100

End Semester Exam : 3 Hours

COURSE OBJECTIVES
1. To make the students to design a system, component, or process to meet desired needs.
2. To prepare the students to design the components with realistic constraints.
3. To make the students to consider economic, environmental, ethical, health and safety when they design.
4. To make the students to design the components with considering manufacturability, and sustainability.
5. To prepare the students to communicate effectively use the techniques, skills, and modern engineering tools.
6. To make the students to understand to use necessary for engineering practice.

COURSE OUTCOMES
On completion of this course, students will be able to
1. Introduction to engineering design and its place in society
2. Exposure to the visual aspects of engineering design and engineering graphics standards.
3. Exposure to engineering communication effectively.
4. Exposure to 3D freehand sketching.
5. Acquired the knowledge of projections of points, lines and plane surfaces.
6. Understand the basic concept of projection of solids.

UNIT I  INTRODUCTION
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Bureau of Indian Standards (BIS), Layout of drawing sheets, sizes of drawing sheets, different types of lines used in drawing practice geometric constructions, principles of dimensioning—linear, angular, aligned system, unidirectional system, parallel dimensioning, chain dimensioning, location dimension and size dimension. Reducing Scale, Enlarging Scale, Plain Scale, Diagonal Scale and Vernier Scale. Conic sections including the Ellipse, Parabola and Hyperbola (eccentricity method only); Cycloid, Epicycloid, Hypocycloid and Involute.

UNIT II  FREE HANDSKETCHING
Representation of Three-Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT III  INTRODUCTION TO COMPUTER GRAPHICS – 2D
Overview of Computer Graphics, listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars, Drawing Area, Dialog boxes and windows, Shortcut menus, The Command Line (where applicable), Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Annotations, layering & other functions.

UNIT IV  PROJECTION OF POINTS AND LINES
Projection of points and straight lines located in the first quadrant inclined to both planes – Determination of true lengths and true inclinations.

UNIT V  PROJECTION OF PLANESURFACES
Projection of polygonal surface and circular lamina inclined to both reference planes.

SUGGESTED READINGS
COURSE OBJECTIVES

The goal of this course is for students to

1. To help students acquire their ability to speak effectively in real life situations.
2. To enable students to communicate in effective way without any barriers.
3. To inculcate the habit of listening and to develop their effective listening skills.
4. To ensure that students use different aids in order to attain effective communication.
5. To enable students to improve their group behavior and presentation skill.
6. To enable students to improve their lexical, grammatical and communicativecompetence.

COURSE OUTCOMES

Students undergoing this course will be able to

1. Enrich comprehension and acquisition of listening, speaking & writing ability.
2. Gain confidence in using English language and develop leadership qualities.
3. To guide the students to effectively manage the team as a team player.
4. To develop the students Interpersonal and Interview skills.
5. Use English language for communication: verbal & non –verbal
6. To enable students to prepare for oral communication in formal contexts.

Unit: I - COMMUNICATION SKILLS:

Communication Skills: Introduction, Definition, The Importance of Communication
The Communication Process – Source, Message, Encoding, Channel, Decoding Receiver, Feedback, Context
Barriers to Communication: Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional Barriers
Perspectives in Communication: Introduction, Visual Perception, Language, Other factors affecting our perspective-Past Experiences, Prejudices, Feelings, Environment

Unit: II - ELEMENTS OF COMMUNICATION

Introduction, Face to Face Communication- Tone of Voice, Body Language (Non-verbal communication), Verbal Communication, Physical Communication.

Unit: III - BASIC LISTENING SKILLS

Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations.
Writing Effectively: Subject Lines, Put the Main Point First, Know Your Audience Organization of the Message.

Unit: IV - INTERVIEW SKILLS AND GIVING PRESENTATIONS

Purpose of an interview, Do’s and Don’ts of an interview- Dealing with Fears, planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery.

Unit: V. - WRITING PRACTICES

Group Discussion: Introduction, Communication skills in group discussion, Do’s and Don’ts of group discussion
Note: Students shall have hands on training in improving Speaking skill in the language laboratory @ 2 periods per each unit.

SUGGESTED READINGS

SEMESTER II

20BEME202  MATHEMATICS - II  4 H – 4 C

Instruction hours / week L : 3 T : 1 P: 0  Marks: Internal : 40 External : 60 Total:100

End Semester Exam :3Hours

COURSE OBJECTIVES:

The goal of this course is for the students

1. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
2. To calculate and establish identities connecting these quantities, to evaluate line, surface and volume integrals in simple coordinate systems and to use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.
3. To enable the students to apply the knowledge of Mathematics in various Engineering fields by making them to identify the functions in engineering problems as analytic function and their study as a function of a complex variables.
4. To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, to specify some difficult integration that appears in applications can be solved by complex integration in application areas such as fluid dynamics and flow of the electric current.
5. To equip the students to Understand the basic concepts of one- and two-dimensional random variables.
6. To use Laplace transforms efficiently for solving the problems that occur in various branches of engineering disciplines.

COURSE OUTCOMES:

Upon completion of this course the students will be able

1. To apply integration to compute multiple integrals, area, volume, integrals in polar and Cartesian coordinates, in addition to change of order and vector integration.
2. To acquaint the student with the concepts of vector calculus, needed for problems in all Engineering disciplines
3. To find the Analytic functions using the Cauchy Riemann equations and they will learn mapping properties of elementary functions and mapping properties of some special transcendental functions.
4. To understand relations between conformal mappings and quadratic differentials and how geometric structures are changing under conformal mappings.
5. To evaluate complex integrals using the Cauchy integral formula and the residue Theorem and to appreciate how complex methods can be used to prove some important theoretical results.
6. To evaluate Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients

UNIT I - MULTIPLE INTEGRALS

Double integral – Cartesian coordinates – Polar coordinates – Area as double integrals -Change of order of integration – Triple integration in Cartesian co-ordinates

UNITII- 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 parallelopipeds.

UNITIII-ANALYTIC FUNCTIONS

Analytic functions - Cauchy-Riemann equations in Cartesian and polar forms – Sufficient condition for an analytic function (Statement Only) - Properties of analytic functions – Constructions of an analytic function - Conformal mapping: w = z+a, az, 1/z and bilinear transformation.
UNIT IV - COMPLEX INTEGRATION

Complex Integration - Cauchy’s integral theorem and integral formula (Statement Only) – Taylor series and Laurent series - Residues – Cauchy’s residue theorem (Statement Only) - Applications of Residue theorem to evaluate real integrals around unit circle and semi circle (excluding poles on the real axis).

UNIT V - LAPLACE TRANSFORM


Total : 60

SUGGESTED READINGS:


WEBSITES:

1. www.intmath.com
2. www.efunda.com
3. www.mathcentre.ac.uk
4. www.sosmath.com/diffeq/laplace/basic/basic.html
COURSE OBJECTIVES
The Goal of this course is for students to
1. Introduce the essential theorems, principles and its applications of Motion
2. Impart the basic knowledge about rigid body dynamics and friction.
3. Inculcate the concepts of viscosity and its measurement techniques.
4. To learn about the strengthening mechanisms for Non-ferrous alloys.
5. Disseminate the magnetic, dielectric and super conducting properties of materials and their applications.
6. Introduce the essential principles of materials science for mechanical and related engineering applications.

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Have knowledge on the various types of motions and their applications.
2. Acquire knowledge on rigid body dynamics and friction.
3. Understand the concept of viscosity and various measurement techniques.
4. Gain knowledge on magnetic, dielectric and superconducting properties of materials.
5. Understand the basics of ceramics, composites and nanomaterials.
6. Get fundamental knowledge on engineering mechanics and composite materials.

UNIT I MOTION AND SYSTEM OF PARTICLES
Motion: Newton’s Laws of Motion, Motion in a resistive medium; Drag force & Drag Coefficient, Drag force – derivation for velocity and position - terminal velocity.
System of particles: Centre of mass of rigid bodies – General expression; Newton's law for a system of particles; Linear momentum for a particle and a system of particles; Conservation of linear momentum; System with varying mass; Single stage Rocket, motion - Velocity & Acceleration with and without gravity; Elastic and inelastic collisions.

UNIT II DYNAMICS OF RIGID BODY AND FRICTION
Moment of Inertia - Kinetic energy and angular momentum of rotating body - centripetal and centrifugal force - Theorems of perpendicular and parallel axes - smooth surface - Compound pendulum - Centre of suspension and centre of oscillation - Centre of percussion - Minimum period of a compound pendulum - Kater’s pendulum. Friction - Laws of friction - Resultant reaction - Angle and cone of friction - Equilibrium of a body on a rough plane inclined to the horizontal - The friction clutch.

UNIT III VISCOSITY
Newton’s law of viscous flow - streamlined and turbulent motion - Reynold’s number - Poiseuille’s formula for the flow of a liquid through a horizontal capillary tube - Experimental determination of co-efficient of a liquid by Poiseuille’s method - Ostwald’s viscometer –Stokes’ formula - Viscosity of gases - Meyer’s formula - Rankine’s method - Variation of viscosity with temperature and pressure - Lubrication. Equation of continuity of flow - Euler’s equation for unidirectional flow - Bernoulli’s theorem – Filter pump and Wings of aeroplane - Torricelli’s theorem - Pitot tube.

UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS
UNIT V – NEW ENGINEERING MATERIALS

SUGGESTED READINGS


JOURNALS

1. Journal of Applied Mechanics (ASME)
2. Journal of Alloys and Compounds (ELSEVIER)
3. Ceramics International (ELSEVIER)
4. Magnetism and Magnetic Materials (ELSEVIER)
5. IEEE Transactions on Magnetics (IEEE)
6. Journal of Superconductor and Novel Magnetism (SPRINGER)

WEBLINKS

1. https://nptel.ac.in/courses/122104014/
2. https://nptel.ac.in/courses/118104008/
3. https://nptel.ac.in/courses/115101012/
THEORY

COURSE OBJECTIVES
1. To impart the basic knowledge about the Electric circuits.
2. To understand the concept of Electro Mechanical Energy Conversion and Transformers.
3. To understand the working of Semiconductor devices and Measuring Instruments.
4. To understand and analyze basic electric and magnetic circuits.
5. To study the working principles of electrical machines and power converters.
6. To impart the basic knowledge of Digital Circuits.

COURSE OUTCOMES
At the end of this course, students will be able to
1. Attributing the electric circuits with DC and AC excitation by applying various circuit laws.
2. Attributing the magnetic circuits and transformer.
3. Reproduce the two port networks.
4. Evaluate the various digital circuits in real time applications.
5. Analysis various semiconductor devices in real time applications.
6. Reproduce the Measuring Instruments.

UNIT I - DC CIRCUITS

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

UNIT III - ELECTRICAL MACHINES AND TRANSFORMER

UNIT IV - SEMICONDUCTOR DEVICES AND DIGITAL ELECTRONICS
Bipolar Junction Transistor – Characteristics. Introduction to operational Amplifier – Model–Applications. Number systems – binary codes - logic gates - Boolean algebra, laws & theorems

UNIT V - MEASURING INSTRUMENTS AND ELECTRICAL INSTALLATION
SUGGESTED READINGS

WEBSITES:
1. www.nptel.ac.in.
COURSE OBJECTIVES

1. To prepare the students to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
2. To prepare the students to communicate effectively and to use the techniques, skills, and modern engineering tools necessary for engineering practice.
3. To provide practical knowledge on preparing holes with higher finish by Drilling / Tapping / Reaming.
4. To facilitate the understanding of surface and cylindrical grinding operations for surface finish.
5. To introduce single and multi-point cutting tools.
6. To impart knowledge on the operations in Capstan and Turret Lathe.

COURSE OUTCOMES

Upon completion of this course, the students will gain
1. Knowledge of the different manufacturing processes which are commonly employed in the industry.
2. To fabricate components using different materials.
3. Students will be able to fabricate components with their own hands.
4. Acquire knowledge on the working principles of machines.
5. Practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
6. By assembling different components, they will be able to produce small devices of their interest.

(i) LECTURES &VIDEOS:

Detailed contents
1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additivemanufacturing
3. Fitting operations & powertools
4. Electrical &Electronics
5. Carpentry
6. Plastic molding, glasscutting
7. Metalcasting
8. Welding

(ii) WORKSHOPPRACTICE:

1. Machineshop
2. Fittingshop
3. Carpentry
4. Electrical &Electronics
5. Weldingshop
6. Casting
7. PlumbingExercises

SUGGESTEDREADINGS

COURSE OBJECTIVES
1. To prepare the students to make section of solids like Prism, Cylinder, and Pyramid.
2. To prepare true shape of section.
3. To gain the knowledge on lateral surfaces.
4. To acquire the knowledge about development of surfaces like Prisms, pyramids, cylinders and cones.
5. To gain the knowledge on 2D drawing using CAD software.
6. To acquire the knowledge on basics of 3D modeling packages.

COURSE OUTCOMES
On completion of this course, students will be able to
1. The students to draw section of solids like Prism, Cylinder, and Pyramid.
2. Students can prepare true shape of section.
3. Students gain the knowledge on lateral surfaces.
4. Students acquire the knowledge about development of surfaces like Prisms, pyramids, cylinders and cones.
5. Students gain the knowledge on 2D drawing using CAD software.
6. Students acquire the knowledge on basics of 3D modeling packages.

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

UNIT II SECTION OF SOLIDS
Sectioning of Prism, Cylinder, Pyramid, and Cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

UNIT III DEVELOPMENT OF SURFACES
Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT IV COMPUTER GRAPHICS – 3D
Introduction to 3D modeling packages. Drafting practices - modeling of simple engineering components, sections and extraction of 2D drawings.

UNIT V ISOMETRIC PROJECTIONS
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple solids, truncated prisms, pyramids, cylinders and cones; Conversion of Isometric Views to Orthographic Views and Vice-versa

SUGGESTED READINGS:
COURSE OBJECTIVES:

The goal of this course is for the students
1. To introduce the basic concepts of PDE for solving standard partial differential equations
2. To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
3. To provide an overview of probability and statistics to engineers
4. To introduce the basic concepts of two-dimensional random variables
5. To acquaint the knowledge of testing of hypothesis for small samples.
6. To acquaint the knowledge of testing of hypothesis for large samples this plays an important role in real life problems.

COURSE OUTCOMES:

Upon Completion of this course the students will be able
1. To solve field problems in engineering involving PDEs.
2. To appreciate the physical significance of Fourier series techniques in solving one- and two-dimensional heat flow problems and one-dimensional wave equations.
3. To apply the basic concepts of probability and have knowledge of standard distribution which can describe real life phenomenon.
4. To apply one- and two-dimensional random variables to solve engineering applications.
5. To formulate and solve problems involving random variables and apply statistical methods for analyzing experimental data
6. To apply the concept of testing of hypothesis for small and large samples in real life problems.

UNIT I - PARTIAL DIFFERENTIAL EQUATIONS

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method.

UNIT II - APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Second-order linear equations and their classification, Initial and boundary conditions, D'Alembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variable.

UNIT III - PROBABILITY AND RANDOM VARIABLES

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities

UNIT IV - TWO-DIMENSIONAL RANDOM VARIABLES

Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule. Basic Statistics, Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation. Curve fitting by the method of least squares-fitting of straight lines, second degree parabolas and more general curves.
UNIT V - TESTING OF HYPOTHESIS

Test of significance: Large sample test for single proportion, difference of proportions, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

SUGGESTED READINGS:


WEBSITES:

1. www.cut-theknot.org/probability.shtml
2. www.mathcentre.ac.uk
3. www.mathworld. Wolfram.com
4. www.sosmath.com
COURSE OBJECTIVE

The goal of this course is for students
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 concepts of force, laws of mechanics and unit systems.
2. Develop free body diagrams for a mechanical system and to apply equilibrium conditions for effective design.
3. Determine the centroid and second order moment for a plane figure.
4. Analyze statically determinate planar frames.
5. Analyze the motion and calculate trajectory characteristics.
6. Understand the concepts of kinetics of particles and friction.

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


UNIT IV  KINEMATICS OF PARTICLES


UNIT V  KINETICS OF PARTICLES AND FRICTION


SUGGESTED READINGS

SEMESTER – III

20BEME303 THERMODYNAMICS 4 H – 4 C

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

COURSE OBJECTIVE

The goal of this course is for students
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 psychometric 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 system
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 psychrometric properties and various processes to create human comfort at various physical conditions.

UNIT I BASIC CONCEPTS AND FIRST LAW


UNIT II SECOND LAW AND ENTROPY

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


UNIT IV PROPERTIES OF PURE SUBSTANCE AND GASMIXTURES


UNIT V PSYCHROMETRY


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

(i) THEORY

COURSE OBJECTIVE
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. Know the methods of inspecting the castings
3. Decide the type of metal joining processes.
4. Work with various metal forming processes
5. Work with various sheet metal operations.
6. Select the type of deformation processes.

UNIT I CASTING PROCESSES

UNIT II JOINING PROCESSES

UNIT III METAL FORMING PROCESSES

UNIT IV SHEET METAL OPERATIONS

UNIT V POWDER METALLURGY PROCESS

SUGGESTED READINGS
(ii) LABORATORY

COURSE OBJECTIVES:

• To teach the process-level dependence of manufacturing systems through tolerances.
• To expose the students to a variety of manufacturing processes including their typical use and capabilities.
• To teach the important effects that manufacturing processes may have on the material properties of the processed part with a focus on the most common processes.

COURSE OUTCOMES:

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

1. Understand the idea for selecting materials for patterns.
2. Types and allowances of patterns used in casting and analyze the components of moulds.
3. Design core, core print and gating system in metal casting processes.
4. Understand the application of arc and gas welding in industries.
5. Understand the principle behind the sheet metal forming process.
6. Understand the working of the powder metallurgy process.

LIST OF EXERCISES

METAL CASTING:

• Pattern Design and making – for one casting drawing.
• Sand properties testing – Exercise - for strengths, and permeability.
• Moulding Melting and Casting.

WELDING:

• Exercises in ARCWelding.
• Exercises in GASWelding.

SHEET METAL FORMING:

• Develop a flat blank layout from an assembly print, transfer the layout to the sheet metal, cut and form to the desired shape.

POWDER METALLURGY:

• Form parts from metallic powders, record and plot pressing data, perform destructives tests on sintered powder metal parts.
COURSE OBJECTIVES

The goal of this course is for students

1. To explain the surfaces for sheet metal working applications.
2. To understand the representation of details in machine drawing.
3. To introduce tolerances and fits of machine elements.
4. To equip them with skills to construct an assembly drawing using part drawings of machine components.
5. To equip them with skills to construct an assembly drawing of machine components using 2D drafting.
6. To equip them with skills to develop employability.

COURSE OUTCOMES

Learners should be able to

1. Express the importance of machine drawing and GD&T.
2. Interpret drawings of machine components.
3. Create assembled machinedrawings.
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.

INTRODUCTION


CONVENTIONS

Code of practice for engineering drawing—conventional representation of details—drilled and tapped holes, countersunk and counter bored holes, internal and external threads, undercuts, grooves, chamfers, fillet radii and keyways. Conventions to represent standard components—bolts, nuts, washers, screws, cotters, pins, circlips, bearings, gears, springs and flanges.

FITS AND TOLERANCES

Introduction to Limits, fits and tolerances—need, types, representation of tolerances on drawing, calculation of minimum and maximum clearances and allowances. Geometric tolerance—uses, types of form and position tolerances, symbols, methods of indicating geometric tolerances on part drawings. Surface finish symbols—methods of indicating the surface roughness.

ASSEMBLY DRAWING PRACTICE

Making free hand sketches of typical subassemblies—flange coupling, stuffing box, journal bearings, rolling element bearings, keyed joints, cotter joints.

ASSEMBLY DRAWING PRACTICE USING CAD SOFTWARE


SUGGESTED READINGS

COURSE OBJECTIVES
1. To know about Indian constitution.
2. To know about central government functionalities in India.
3. To know about state government functionalities in TN.
4. To know the relations between central and state government.
5. To know about Right of Women and Children.
6. To know about Indians society.

COURSE OUTCOMES
 Upon completion of the course, students will be able to:
1. Understand the functions of the Indian government.
2. Understand the functions of the state government.
3. Understand the relations between central and state government.
4. Understand and abide the rules of the Indian constitution.
5. Understand and appreciate different culture among the people.
6. Understand the Rights of Women, Children and other Weaker Sections.

UNIT I  INTRODUCTION

UNIT II  STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT
Union Government – Structures of the Union Government and Functions - all India services – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT III  STRUCTURE AND FUNCTION OF STATE GOVERNMENT

UNIT IV  CONSTITUTION FUNCTIONS
Indian Federal System – Center – State Relations – President’s Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

UNIT V  INDIAN SOCIETY
Society: Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

SUGGESTED READINGS
1. Durga Das Basu, Introduction to the Constitution of India, Prentice Hall of India, New Delhi
2. R.C. Agarwal, (1997). Indian Political System, S.Chand and Company, New Delhi,
3. Maciver and Page, Society: An Introduction Analysis, Mac Milan India Ltd, New Delhi
4. K.L. Sharma (1997)., Social Stratification in India: Issues and Themes, Jawaharlal Nehru University, New Delhi,
5. Sharma, Brij Kishore, (2011)., Introduction to the Constitution of India, Prentice Hall of India, New Delhi,
COURSE OBJECTIVES

The goal of this course is for students

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 practitioners.
6. To learn about the systems concepts and methodologies to analyze and understand interactions.

COURSE OUTCOME

1. Master core concepts and methods from ecological and physical sciences and their application in environmental problemsolving.
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 globalscales.
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 - ENVIRONMENTAL STUDIES & ECOSYSTEMS
Environment Definition, Scope and importance; Ecosystem, Structure and functions of ecosystem. Energy flow, Food chains and food webs, Ecological succession. Classification of ecosystem. Forest ecosystem, Grassland Ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

UNIT II NATURAL RESOURCES - RENEWABLE AND NON-RENEWABLE RESOURCES
Natural resources - Renewable and Non – Renewable resources. Land resources and land use change, Land degradation, soil erosion and desertification. Forest resources - Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water resources - Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water. Use of alternate energy sources, growing energy needs, case studies. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

UNIT III BIODIVERSITY AND ITS CONSERVATION

UNIT IV ENVIRONMENTAL POLLUTION
UNIT V SOCIAL ISSUES AND THE ENVIRONMENT

SUGGESTED READINGS
(i) THEORY

COURSE OBJECTIVE
1. To explain the mechanics of metal cutting, cutting tool materials, tool wear and cutting fluids.
2. To understand the concept of constructional features of different types of lathe and their operations.
3. To provide knowledge on construction & working of shaping, milling & drilling machines and gear cutting & finishing process.
4. To expose students to various types of grinding machines and broaching machines.
5. To explain the construction features of different types of CNC machine and manual part programming for a given component.
6. To perform part programming for CNC machines.

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Calculate the cutting force during machining and other parameters related to metalcutting
2. Know the working of various conventional machinetools
3. Prepare manual part programming for simple components for a CNC machine
4. Select the various abrasive processes for different machining conditions.
5. Differentiate and select the various surface finishing methods used
6. Explain the working of the electrical and electrochemical machining processes.

UNIT I THEOREY OF METALCUTTING

UNIT II CONVENTIONAL MACHINETOOLS

UNIT III CNC MACHINING

UNIT IV ABRASIVE PROCESSES

UNIT V ELECTRICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES

SUGGESTED READINGS
(ii) LABORATORY

COURSE OBJECTIVE

1. To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry

COURSE OUTCOME

Upon completion of this course, the students will be able to
1. Perform shaping operation
2. Perform milling & slotting operation
3. Perform drilling, tapping and reaming operation
4. Perform grinding operations
5. Work with tool grinding machine
6. Work in a capstan and turret lathe

LIST OF EXERCISES

1. Exercises in shaping.
2. Exercises in Milling.
3. Exercises in slotting.
4. Exercises in Drilling / Tapping / Reaming.
5. Exercises in Surface grinding and cylindrical grinding process.
7. Exercises in Capstan and Turret Lathe.
Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021.
(ii) LABORATORY

COURSE OBJECTIVE

The goal of this course is for students
1. Ability to conduct experiment on IC engine to study the characteristic and performance of IC design/steamturbines.

COURSE OUTCOME

Upon completion of this course, the students will be able to
1. conduct experiment on IC engine to study the characteristic and performance of ICEngine
2. conduct experiment to find the thermo physical properties of given fluid.

LIST OF EXPERIMENTS

IC ENGINES AND FUELS

2. Performance Test on 4–stroke CI Engine.
4. Load test on 4–stroke CI Engine.
5. Retardation Test to find Frictional Power of a CI Engine.
7. Determination of Flash Point and Fire Point.
8. Performance test on single/two stage reciprocating air compressor.
9. Determination of COP of a refrigeration system
10. Experiments on air–conditioning system
Karpagam Academy of Higher Education (Deemed to be University), Coimbatore – 641 021.
(ii) LABORATORY

COURSE OBJECTIVE

The goal of this course is for students

1. To perform different destructivetesting
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 destructivetesting
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 and Rockwell Hardness tests.
4. Impact test on metals–Charpy, Izod impact tests.
5. Shear test on metals–direct shear strength, single shear, doubleshear.
7. Torsion test on beams–torque and angle of twist characteristics, shear stress, modulus of rigidity, energy.
i) THEORY

COURSE OBJECTIVES
The goal of this course is for students
1. To enrich the understanding of fluid properties
2. To make the students conversant with types of flow and calculate Major and minor loses in pipes.
3. To acquaint the student with the concepts of Buckingham’s \(\pi\) 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. Determine fluid properties to solve engineering problems.
2. Understand the flow characteristics of fluids and its mathematical relations.
3. Identify fluid behaviors and perform dimensional analysis for fluid flow.
4. Characterize the fluid flow in a fixed boundary.
5. Draw velocity vector diagram for hydraulic machines.
6. Investigate performances of hydraulic machines.

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.
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 \(\pi\) theorem, study about Renold’s number and significant for different fluids.

UNIT IV  HYDRAULIC TURBINES

UNIT V  HYDRAULIC PUMPS

SUGGESTED READINGS
(ii) LABORATORY

COURSE OBJECTIVE

The goal of this course is for students
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.
3. To explain the Calibration of Rotameter.
4. To understand the importance of friction factor for flow through pipes.
5. To impart knowledge on the performance of various pumps.
6. To impart knowledge on the performance of turbines.

COURSE OUTCOMES

1. Ability to use the measurement equipment’s for flow measurement
2. Ability to do performance trust on different fluid machinery.
3. Estimate the friction factor for flow through pipes.
4. Asses the performance of centrifugal pump and submersible pump.
5. Asses the performance of reciprocating pump and gear pump.
6. Asses the performance of turbines.

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orificemeter.
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 submersible pump.
7. Conducting experiments and drawing the characteristic curves of reciprocating pump.
8. Conducting experiments and drawing the characteristic curves of Mono block pump.
9. Conducting experiments and drawing the characteristic curves of Pelton wheel.
10. Conducting experiments and drawing the characteristics curves of Francis turbine.
COURSE OBJECTIVE
1. To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.
2. To know the need and importance of protecting traditional knowledge.
3. To know the various government acts and rules for protection of TK.
4. To know the various enactments related to the protection of traditional knowledge.
5. To understand the concepts of Intellectual property to protect the traditional knowledge.
6. To know the traditional knowledge in different sectors like engineering, medicine etc.

COURSE OUTCOMES
Upon completion of the course, the students are expected to:
1. Understand the concept of Traditional knowledge and its importance.
2. Know the need and importance of protecting traditional knowledge.
3. Know the various government acts and rules for protection of TK.
4. Know the various enactments related to the protection of traditional knowledge.
5. Understand the concepts of Intellectual property to protect the traditional knowledge.
6. Know the traditional knowledge in different sectors like engineering, medicine etc.

UNIT I INTRODUCTION
Introduction to traditional knowledge: Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-a-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-a-vis formal knowledge

UNIT II PROTECTION OF TK
Protection of traditional knowledge: the need for protecting traditional knowledge Significance of TK Protection, value of TK in global economy, Role of Government to harness TK.

UNIT III GOVERNMENT ACTS
A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmer's Rights Act, 2001 (PPVFRAct);

UNIT IV INTELLECTUAL PROPERTY RIGHTS
Traditional knowledge and intellectual property: Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional Knowledge.

UNIT V TK IN DIFFERENT SECTORS
Traditional knowledge in different sectors: Traditional knowledge and engineering, Traditional medicine system, TK in air conditioning, TK in biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.

SUGGESTED READINGS
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012.
3. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
4. "Knowledge Traditions and Practices of India" Kapil Kapoor 1, Michel Danino 2
COURSE OBJECTIVES

The goal of this course is for students
1. To understand the various types of stresses induced in different machine members.
2. To study and acquire knowledge on design shafts 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. Design components subjected to steady and variable stresses by considering stress concentration and able to apply various theories of failure.
2. Design solid and hollow shafts based on strength, rigidity and critical speed, also able to design flange coupling and bush pin type coupling.
3. Design bolted joints and welded joints subjected to axial and eccentric loading.
4. Design helical spring, leaf spring subjected to steady and variable loading, also be able to design rim type flywheel.
5. Design of ball bearings of rolling contact type and journal bearing.
6. Design of levers of type I, II and III.

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.

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

SUGGESTED READINGS

5. Design Data: Data Book of Engineers by PSG College-KalaikathirAchchagam– Coimbatore
(i) THEORY

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.

SUGGESTED READINGS
(ii) LABORATORY

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.

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. Perform corrosion test.

LIST OF EXPERIMENTS
1. Study and use of metallurgical microscope (Term Paper).
3. Microstructure of annealed pure metals—iron, copper, lead, zinc aluminium and use of specific etchants.
4. Macro etching and sulphur printing.
5. Electropolishing.
6. Comparative study of microstructure of annealed steel (Hypo eutectoid, Eutectoid, Hyper eutectoid) and variation of hardness.
10. Recovery, Recrystallisation and Grain growth of cold worked copper.
11. Galvanostatic polarization & determination of corrosion rate by Tafel’s Extrapolation
(i) THEORY

COURSE OBJECTIVES

The goal of this course is for students

1. To provide knowledge on various Metrological equipments available to measure the dimension of the components.
2. To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.
3. To enrich the understanding of principles of measuring instruments and gauges
4. To give exposure to inspection of spur gear and thread elements.
5. To equip them with skills to linear measurements using various measuring instruments
6. To give exposure to procedures involved in erecting machineries.

COURSE OUTCOMES

Upon completion of this course, the students will able to

1. Understand the basics of measurements and quality standards.
2. Perform linear measurements using various measuring instruments
3. Perform the geometrical measurements of various components
4. Measure the various dimensions of a screw thread
5. Measure the dimensions of the simple spur gear.
6. Know the procedures involved in erecting machineries.

UNIT I

BASICS OF MEASUREMENT, DEVICES AND QUALITY STANDARDS


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.
TEXT BOOKS

(ii) LABORATORY

COURSE OBJECTIVE

The goal of this course is for students
To gain practical and hands on experience in measuring the mechanical components using various measuring instruments and devices.

COURSE OUTCOME

Upon completion of this course, the students will able to use the different measuring instruments to measure different measurements of given mechanical components.

METROLOGY

1. Calibration of Vernier / Micrometre / Dialgauge
2. Checking dimensions of part using slipgauges
3. Measurement of gear tooth dimensions – addendum, dedendum, pitch circle diameter and tooth thickness
4. Measurement of taper angle using sine bar / tool makersmicroscope
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
THEORY COURSE OBJECTIVES
The goal of this course is for students
1. To understand the basic concepts of heat transfer.
2. To comprehend the fundamentals of convective heat transfer.
3. To learn about different types of heat exchangers and its analysis.
4. To recognize the importance of radiation heat transfer.
5. To study about the basic concepts of mass transfer.
6. To make the students conversant to solve complex problems where heat and mass transfer takes place.

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Formulate and analyze heat transfer problems involving any of the three modes of heat transfer.
2. Obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods empirically.
3. Describe the process involved in phase change heat transfer like condensation, evaporation.
4. Design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.
5. Understand the concepts of radiation and radiation shields.
6. Identify the analogy between heat and mass transfer and concepts of mass transfer.

UNITI CONDUCTION

UNITII CONVECTION

UNITIII PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS

UNITIV RADIATION

UNITV MASS TRANSFER

SUGGESTED READINGS
(ii) LABORATORY

COURSE OBJECTIVE
The goal of this course is for students
1. To study the heat transfer phenomena and predict the relevant coefficient using experiments.

COURSE OUTCOME
1. Students will be able to conduct experiment and determine the heat transfer properties of respective materials.

HEAT TRANSFER
1. Heat transfer through a compositewall
2. Thermal conductivity measurement by guarded platemethod
3. Natural convection heat transfer from a verticalcylinder
4. Heat transfer from pin–fin (natural and forced convectionmodes)
5. Effectiveness of Parallel/counter flow heat exchanger
6. Determination of Stefan–Boltzmannconstant
7. Determination of emissivity of a greysurface
i) THEORY

COURSE OBJECTIVE

The goal of this course is for students
1. To understand the concepts of degrees of freedom and to differentiate the characteristics between mechanism, machine and structure.
2. To analyse the relative motion between machine elements of a mechanism.
3. To understand the basic concepts of gear terminologies and gear trains.
4. To understand the undesirable effects of unbalance forces in a mechanism.
5. To expose students to vibration phenomenon and its types along with the vibration terminologies.
6. To understand the effect of Dynamics due to undesirable vibrations.

COURSE OUTCOMES

Upon completion of this course, students will be able to
1. Develop a 2D sketch for a planner mechanism and to analyze the degrees of freedom for the same.
2. Perform velocity and acceleration analysis for the simple mechanisms.
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  KINEMATIC ANALYSIS AND FRICTION

UNIT III  GEARING AND CAMS
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  FORCE ANALYSIS AND BALANCING

UNIT V  VIBRATION
SUGGESTED READINGS


(ii) LABORATORY

COURSE OBJECTIVES

The goal of this course is for students
1. To supplement the principles learnt in kinematics and Dynamics of Machinery.

COURSE OUTCOME

Upon completion of this course students will be able to
1. Determine the various parameters of governors, Cam & Gyroscopes
2. Determine the critical speed of a given shaft
3. Perform balancing of rotating and reciprocating parts
4. Determine the natural frequency of a given system
5. Determine the mass moment of inertia of a given component
6. Determine the damping coefficient of a single degree freedom system

LIST OF EXPERIMENTS

1. Governors – Determination of sensitivity, effort, etc. for Watt, Porter, Proell, and spring-controlled Governors
2. Cam – Determination of jump speed and profile of the cam.
5. Balancing of rotating and reciprocating masses.
7. Vibrating system – spring mass system – Determination of damping coefficient of single degree of freedom system
8. Determination of torsional frequencies for compound pendulum and flywheel system with lumped moment of inertia.

20BE_______ OPEN ELECTIVE – I 3 H – 3 C

Instruction hours / week L : 3 T : 0 P:0  Marks: Internal : 40 External : 60 Total:100

End Semester Exam : 3 Hours

Students will select the open elective course from the set of open electives offered by various departments which are listed in the table of curriculum.
COURSE OBJECTIVES

1. To understand the concepts of geometrical dimensioning and Tolerancing.
2. To study the physical importance of them in industrial point of view.
3. To know the various types of Tolerancing, its measurement and design.
4. To translate geometric callouts into plain English with one meaning.
5. To explain the major rules found in ASME Y14.5-2009.
6. To understand the hierarchy of geometric tolerancing.

COURSE OUTCOMES

1. Ability to learn and apply geometric dimensioning and tolerance standards to communicate design intent.
2. Ability to Learn how the knowledge of certain processes can affect part design and documentation.
3. Gain added insight on working in a team design environment.
4. Translate geometric callouts into plain English with one meaning.
5. Explain the major rules found in ASME Y14.5-2009.
6. Understand the hierarchy of geometric tolerancing.

INTRODUCTION


FORM AND ORIENTATION TOLERANCE

Design considerations – Flatness and Circularity measurement concepts – Orientation tolerance specification and application design.

POSITION AND RUNOUT TOLERANCE

Profile of surface and line tolerance design and application – Location tolerance, Position, applied and material condition consideration – Coaxial controls and design – Concentricity, Symmetry – Measurement and application – Design considerations – Position, Composite tolerance concept, design and Measurement – Runout, Total Runout tolerances – Measurement and considerations.

SUGGESTED READINGS

4. STANDARDS - IS : 10714, 10715, 10716, 10717, 11669, 10719, 813, 919, 2709, 8000 pt 1 to 10721, 11158 and AWS/ISO
COURSE OBJECTIVES

The goal of this course is for students
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 V –belts, Flatbelts,
2. Design Wire ropes and chain drive.
3. Design spur gear and helical gear
4. Design bevel and worm gear
5. Design multispeed gearbox
6. Design clutches and brakes

UNITI DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS

UNITII DESIGN OF SPUR AND HELICAL GEARS

UNITIII 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.

UNITIV DESIGN OF GEARBOXES

UNITV DESIGN OF CLUTCHES AND BRAKES
Design of plate clutches – axial clutches – cone clutches – internal expanding rim clutches – internal and external shoe brakes.
(Permitted to use PSG design data book in the examination)

SUGGESTED READINGS

5. Design Data: Data Book of Engineers by PSG College-KalaikathirAchchagam– Coimbatore
COURSE OBJECTIVES
1. To provide a basic knowledge about measurement systems and their components
2. To learn about various measurements like displacement, temperature, pressure, level, flow, speed
3. To learn about control systems and its principles.
4. To learn how to measure the quantities like strain, humidity and force
5. To learn how to measure the quantities like torque and power
6. To classify the various control methods and its application.

COURSE OUTCOME
Upon completion of this course, the Students will be able to
1. Understand the measurement systems, their accuracy & range.
2. Measure the quantities like displacement, temperature, pressure
3. Measure the quantities like level, flow and speed
4. Measure the quantities like strain, humidity and force
5. Measure the quantities like torque and power
6. Classify the various control methods and its application and do system models and perform response analysis

UNIT I INTRODUCTION

UNIT II MEASUREMENTS I

UNIT III MEASUREMENTS II

UNIT IV MEASUREMENTS III

UNIT V CONTROL SYSTEMS

SUGGESTED READINGS
SEMESTER – VI

20BEME603 POWER PLANT ENGINEERING 3 H – 3 C

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

COURSE OBJECTIVES

The goal of this course is for students
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. Explain the working principles of various types of boilers
4. Explain the working of nuclear and MHD power plant.
5. Apply appropriate type of renewable energy technologies for generating electricity depending upon the application and availability.
6. Identify the type of pollution control method required for power plant.

UNIT I  STEAM POWER PLANT

UNIT II  SOLAR AND WIND POWER PLANT

UNIT III  NUCLEAR AND HYDEL POWERPLANTS

UNIT IV  DIESEL AND GAS TURBINE POWERPLANT

UNIT V  OTHER POWER PLANTS AND ECONOMICS OF POWERPLANTS

SUGGESTED READINGS
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<th>Course Title</th>
<th>Credits</th>
<th>Instruction Hours/Week</th>
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<td>Internal: 40 External: 60 Total: 100</td>
<td>3 Hours</td>
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</table>
COURSE OBJECTIVE

The goal of this course is for students
1. To gain practical experience in handling 2D drafting and 3D modeling softwaresystems.
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 understand the importance of MAT Lab for simulating different systems
6. To acquaint the student with the concepts of mat lab for performing various mathematical operations.

COURSE OUTCOME

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 SolidWorks for modeling of given components
3. create assembly of components
4. prepare manufacturing drawings from the models created
5. Use MAT Lab for simulating different systems like hydraulic and pneumatic circuits
6. Use mat lab for performing various mathematical operations

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.

COMPUTER AIDED SIMULATION

1. Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP using Software
2. Simulation of Hydraulic / Pneumatic cylinder using Software
3. Simulation of cam and follower mechanism using Software
4. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
5. Use of MATLAB to solve simple problems invibration
COURSE OBJECTIVE
1. To expose students to problem definitions
2. To understand the Fabricate device/system/component(s) for problem solving.
3. To equip them subject knowledge to solve real world problems.
4. To acquaint the student to newer techniques to improve the performance of a device/system.
5. To develop the skill to prepare the project reports
6. To develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE OUTCOMES
1. Formulate problem definitions
2. Fabricate device/system/component(s) for problem solving.
3. Apply subject knowledge to solve real world problems.
4. Implement newer techniques to improve the performance of a device/system.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE DESCRIPTION
The students may be grouped into maximum of 4 students and work under a project supervisor. The device/system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible, with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department.
COURSE OBJECTIVES
1. To understand the working principles of pumps
2. To understand the working principles of motors
3. To develop the system curve
4. To calculate the Net Positive Suction Head
5. To calculate the pump Total Head versus Rate of Flow characteristic
6. To match pumps to variable, parallel and series pumping systems

COURSE OUTCOMES
1. Understand the working principles of pumps.
2. Understand the working principles of motors.
3. Develop the system curve.
4. Calculate the Net Positive Suction Head.
5. Calculate the pump Total Head versus Rate of Flow characteristic.
6. Match pumps to variable, parallel and series pumping systems.

UNIT I SINGLE PHASE INDUCTION MOTOR

UNIT II THREE PHASE INDUCTION MOTOR

UNIT III PUMPS
Pumps: Definition and Terminologies – classifications – Applications, Cavitation in pump – rotary pumps: working principles of gear and vane pumps, Trouble shooting.

SUGGESTED READINGS
(i) THEORY

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

UNIT II AUTOMATED MANUFACTURING SYSTEMS

UNIT III GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS

UNIT IV QUALITY CONTROL SYSTEMS AND INSPECTION TECHNOLOGIES

UNIT V MANUFACTURING SUPPORT SYSTEM

SUGGESTED READINGS:
(ii) LABORATORY

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 create part programming involving different motions.
5. To understand the working of standard canned cycles.
6. To generate NC code using software’s

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Create manual part programming for various components using G and M codes
2. Expose students to modern control systems (Fanuc, Siemens, etc.)
3. Know the application of various CNC machines like CNC lathe, CNC Vertical Machining Centre
4. Create part programming involving different motions.
5. Understand the working of standard canned cycles.
6. Generate NC code using software’s

LIST OF EXPERIMENTS
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.
5. CNC Controllers like FANUC, Siemens, and Hiedenhain etc.
(i) THEORY

COURSE OBJECTIVES

The goal of this course is for students
1. To get the knowledge on CAD/CAM systems.
2. To introduce the students to various techniques in CAD and help them to gain proficiency in developing mathematical models and CNC programmes.
3. To understand the concept of finite element method for displacement and nodal forces.
4. To gain knowledge of numerical calculations and computer tools for validation.
5. To study the convergence of output results and validate through theoretical approach.
6. To introduce the concepts of coding behind working of finite element concepts

COURSE OUTCOMES

Upon completion of this course, the students will
1. Understand geometric transformation techniques in CAD.
2. Develop mathematical models to represent curves and surfaces and model engineering components using solid modeling techniques.
3. Develop CNC programs to manufacture industrial components.
4. Apply core mechanical concept to provide preliminary results of nodal force and displacement using FEM.
5. Explain the coding behind working of finite element concept for validation of static structural and thermal analysis.
6. Interpret the results of finite element analysis and make an assessment results in terms of modeling Discretization.

UNIT I INTRODUCTION TO CAD/CAM AND GEOMETRIC MODELING


UNIT II CAM AND CNC


UNIT III INTRODUCTION TO FEM


UNIT IV ONE AND TWO DIMENSIONAL PROBLEMS


UNIT V AXISYMMETRIC AND ISOPARAMETRIC CONTINUUM

SUGGESTED READINGS:


(ii) LABORATORY

COURSE OBJECTIVES

The goal of this course is for students
1. To perform simple structural analysis and thermal analysis using simulation software’s.
2. To perform structural analysis of bars and trusses.
3. To perform structural analysis of beams and frames.
4. To perform 2D analysis of plate and shells.
5. To perform modal analysis of simple systems.
6. To perform thermal analysis of simple systems.

COURSE OUTCOMES

Upon completion of this course, the Students will be able to
1. Perform structural analysis of bars and trusses.
2. Perform structural analysis of beams and frames.
3. Perform 2D analysis of plate and shells.
4. Perform modal analysis of simple systems.
5. Perform thermal analysis of simple systems.
6. Perform fluid and failure analysis of simple systems.

LIST OF EXPERIMENTS

(Simple Analysis using ANSYS Tool)

1. Structural Analysis (Static)
   1d and 2d analysis of:
   - Bar and trusses,
   - Beams & frames,
   - Plate and shell structures.
2. Structural vibration analysis (Dynamic)
   - Modal analysis
   - Frequency response analysis
   - Transient response analysis
3. Thermal analysis – simple problems
4. Fluid Analysis – simple problems
5. Failure analysis – simple problems
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SEMESTER – VII

20BEME791  PROJECT WORKPHASE -I  6 H – 3 C

Instruction hours / week L : 0 T : 0 P:6  Marks: Internal :100  External : --Total:100

COURSE OBJECTIVES

1. To expose students to problem definitions
2. To understand the Fabricate device/system/component (s) for problem solving.
3. To equip them subject knowledge to solve real world problems.
4. To acquaint the student to newer techniques to improve the performance of a device/system.
5. To develop the skill to prepare the project reports
6. To develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE OUTCOMES

1. Formulate problem definitions
2. Fabricate device/system/component (s) for problem solving.
3. Apply subject knowledge to solve real world problems.
4. Implement newer techniques to improve the performance of a device/system.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE DESCRIPTION

The students in a group consisting of maximum of 4 students 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. The project work carried out in this semester may be a standalone project or part of the work of project work –V carried out in the eighth semester.
COURSE OBJECTIVE
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.
2. To expose students to problem definitions.
3. To understand the Fabricate device/system/component(s) for problem solving.
4. To equip them subject knowledge to solve real world problems.
5. To acquaint the student to newer techniques to improve the performance of a device/system.
6. To develop the skill to prepare the project reports

COURSE OUTCOMES
1. Formulate problem definitions
2. Fabricate device/system/component(s) for problem solving.
3. Apply subject knowledge to solve real world problems.
4. Implement newer techniques to improve the performance of a device/system.
5. Develop the skill to prepare the project reports
6. Develop the skill to prepare power point presentation and to face reviews and viva voce examination.

COURSE DESCRIPTION
The students in a group consisting of maximum of 4 student’s works on a topic approved by the head of the department under the guidance of a faculty member and prepare 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.
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 applications.
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 applications.
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 RECENT ADVANCEMENT IN COMPOSITES


SUGGESTED READINGS

COURSE OBJECTIVES

The goal of this course is for students

1. To understand the different energy resources and their impacts.
2. To provide knowledge on energy production from solar plants.
3. To impart knowledge on wind mills, tide and geo thermal energy conservations.
4. To provide basic knowledge on production of biomass energy.
5. To understand the economic analysis of an OTEC powerplant.
6. To understand the basic principles fuel cell, Geo thermal power plants.

COURSE OUTCOMES

Upon completion of this course, the students can able to
1. Determine the impacts of harnessing different renewable energy.
2. Analyze and design solar cells so as to improve its performance.
3. Explain energy generation techniques in wind mills, tide and geo thermal powerplant.
4. Understand the technique of harvesting energy from bio mass and biowastes
5. Perform economic analysis for OTEC powerplants.
6. Get basic knowledge on fuel cells, solar cells, thermionic generator etc.

UNIT I ENERGY AND ENVIRONMENT


UNIT II SOLARENERGY


UNIT III WIND, TIDAL AND GEO THERMALENERGY

Energy from the wind – general theory of windmills – design aspects of horizontal axis windmills – applications, performance and site selection of windmills. 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 BIOENERGY

Energy from bio mass and bio gas plants – pyrolysis, gasification, combustion and fermentation – various types – design principles of biogas plants – applications. Utilization of industrial and municipal wastes – energy from the agricultural wastes.

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

SUGGESTED READINGS


WEB REFERENCES

1. https://nptel.ac.in/courses/121106014/
2. https://www.studentenergy.org/topics/renewable-energy
COURSE OBJECTIVES

The goal of this course is for students
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 MACHINEVISION


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 effector commands, and Simple programs

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS


SUGGESTED READINGS

COURSE OBJECTIVE

The goal of this course is for students
1. To recognize symbols and fundamentals in fluid power generation and distribution.
2. To identify power source for hydraulics systems.
3. To select appropriate components used in various hydraulics 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 hydraulics systems.
3. Select appropriate components used in various hydraulics 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 POWER SOURCES AND ACTUATORS


UNIT III  HYDRAULIC CONTROL VALVES AND COMPONENTS


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.

SUGGESTED READINGS

COURSE OBJECTIVES
The goal of this course is for students
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  AIR CONDITIONING

SUGGESTED READINGS
COURSE OBJECTIVE

The goal of this course is for students
1. To enhance specified concepts and skills regarding various processes including powder metallurgy and foundry techniques.
2. To learn about wide range of welding process, which are currently used in the manufacturing industry.
3. To acquire knowledge to understand the working concept of sheet metal and forming process.
4. To learn about various machining process parameters, influence on performance and applications.
5. To learn the concepts of rapid product development, apply acquired knowledge to meet global challenges in changing design in time compressed mode.
6. To provide knowledge on optimum parametric for advanced manufacturing process.

COURSE OUTCOME

Upon the completion of this course, the students will be able to
1. Understand the concepts and processing parameters of powder metallurgy process.
2. Different kinds of metal joining processes.
3. Explain various sheet metal making processes.
4. Summarize various hot working and cold working methods of metals.
5. Describe the constructional and operational features of modern machining process.
6. Understand the importance of rapid prototyping in the product development.

UNIT I   POWDER METALLURGY AND FOUNDRY TECHNIQUES

Introduction to powder metallurgy process – preparation of powders – types and functions of binders – green compaction – sintering process and its effect on the product. High pressure moulding, Squeeze casting, Vacuum castings

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


WEB REFERENCES

1. https://nptel.ac.in/courses/112107078/
COURSE OBJECTIVE

The goal of this course is for students
1. To understand the Fundamentals of Vibration and its practical applications
2. To understand the working principle and operations of various vibrations Measuring instruments.
3. To understand the various Vibration control strategies.
4. To understand the various Vibration control strategies
5. To equip them with skills to solve mathematically a multi-degree freedom system & continuous system
6. To give exposure to the various experimental methods used for vibration analysis

COURSE OUTCOMES

At the end of the course, the student will be able to:
1. Define the terms involved in vibrations system.
2. Describe the importance of vibration isolation
3. Explain the working nature of two degree of freedom systems
4. Solve mathematically a multi-degree freedom system & continuous system
5. List the various techniques used in vibration control
6. Explain the various experimental methods used for vibration analysis.

UNIT I SINGLE DEGREE FREEDOM SYSTEM


UNIT II TWO DEGREE FREEDOM SYSTEM

Introduction-Free Vibration of Undamped And Damped- Forced Vibration With Harmonic Excitation System – Coordinate Couplings And Principal Coordinates.

UNIT III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM


UNIT IV VIBRATION CONTROL


UNIT V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS


SUGGESTED READINGS

COURSE OBJECTIVES
The goal of this course is for students
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 and its advantages, 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, Properties of Battery, Battery Efficiency, Battery pack design. 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.

SUGGESTED READINGS
COURSE OBJECTIVES
The goal of this course is for students
1. To study the various factors influencing the manufacturability of components and the use of tolerances in manufacturing.
2. To understand the importance of the DFM approach and guidelines.
3. To enrich the understanding of the selective assembly and Datum systems.
4. To introduce the concepts of demonstrate true Position tolerancing theory.
5. To develop an understanding of the standard techniques and redesigning cast members using weldments and plastic component manufacturing.
6. To equip them with skills on Tolerance Charting Technique.

COURSE OUTCOMES
Upon completion of this course, the students will be able to,
1. Understand the importance of DFMA in industrialscenerio
2. Implement the tolerancesanalysis.
3. Identify different types of tolerance allocationmethods.
4. Practice the geometric dimensioning and toleranceconcepts.
5. Prepare tolerancechart.
6. Implement DFM concepts in practice.

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; 6σ concept; Tolerance Analysis: Process capability, process capability metrics, Cp, Cpk, 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 normallaw.

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–machining considerations, redesign for manufacture, examples.

SUGGESTED READINGS

TOTAL
COURSE OBJECTIVES

The goal of this course is for students
1. To introduce Governing Equations of viscous fluid flows.
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.
5. To understand basic properties of computational methods – accuracy, stability, consistency.
6. To understand the importance 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 differencemethod.
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 FEM TECHNIQUES
FEM techniques in CFD, strong and weak Boundary, Value problem, Weighted residual formulation, galerkin foundation, variational formulation, implementation of FEM.

UNIT IV HEAT CONDUCTION, CONVECTION AND DIFFUSION
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. 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 FLOWFIELD

SUGGESTED READINGS

COURSE OBJECTIVES
The goal of this course is for students
1. To understand and analyze the energy data of industries
2. To carryout energy accounting and balancing of industrial boilers.
3. To conduct energy audit and suggest methodologies for energy savings of furnaces.
4. To learn energy conservation opportunities of electrical components.
5. To utilize the available resources in optimal ways.
6. To make the students conversant with concepts of industrial furnaces

COURSE OUTCOMES:
At the end of the course, student will be able to
1. Understand the Environmental aspects of energy utilization
2. Perform combustion analysis
3. Explain the concepts of industrial boiler
4. Understand how to work with the steam generated from the boilers in the industrial point of view
5. Explain the concepts of industrial furnaces
6. Perform Energy audit

UNIT I ENERGY SCENARIO
Present status, rate of growth, energy utilization (sector wise), concept of energy conservation, energy economics.

COMBUSTION: Fuel analysis, combustion calculations, air requirements, theoretical and excess air requirements, excess air control, flue gas analysis and measurement, types of draught, draught calculations, chimney size calculations. F.D and I.D fan draught requirements and power requirements, furnace pressure requirements.

UNIT II INDUSTRIAL BOILERS
Types and characteristics of industrial boilers, heat balance in boilers, efficiency trials in boilers, energy conservation opportunities in boilers operation and maintenance, water treatment requirements, soot blowing requirements, super heaters and superheat controls, waste heat recovery systems.

STEAM: Distribution requirements of steam and steamlines, efficient utilization of steam, steam trapping and air venting, flash steam recovery, condensate recovery, thermal insulation for systems including HVAC, steam balance calculations.

UNIT III INDUSTRIAL FURNACES
Furnace types and characteristics, heat balance in furnaces, furnace efficiency calculations, energy conservation opportunities in furnaces, refractories types and properties, waste heat recovery system, insulating refractories, ceramic fibers, heat loss reduction calculations, wall and stored heat loss reduction.

UNIT IV ENERGY CONSERVATION OF ELECTRICAL COMPONENTS

UNIT V ENERGY AUDIT AND APPLICATIONS
Types, methodology, questionnaire development, specific energy consumption (unitwise/section wise), identification of energy conservation measures/ technologies, economic and cost benefit analysis, case studies, Energy rating for thermal equipment, Energy saving measurement – Star status – National awards.

SUGGESTED READINGS
COURSE OBJECTIVES
The goal of this course is for students
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 biostream.

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 biostream.

UNIT I  INTRODUCTION

UNIT II  CAD & REVERSE ENGINEERING

UNIT III  LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS
Classification – Liquid based system – Stereo lithography 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

SUGGESTED READINGS
COURSE OBJECTIVES
The goal of this course is for students
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 RocketPropulsion.
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

COURSE OUTCOMES
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.

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS

UNIT II FLOW THROUGH DUCTS
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.

UNIT III NORMAL AND OBLIQUE SHOCKS
Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Use of table and charts – Applications.

UNIT IV JET PROPULSION

UNIT V ROCKET PROPULSION

(Permitted to use standard Gas Tables in the examination)

SUGGESTED READINGS
COURSE OBJECTIVE

The goal of this course is for students
1. To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.
2. To understand the concepts of sensors and transducers.
3. To provide an overview of actuation systems.
4. To expose students to controller model for electrical, mechanical and thermal systems.
5. To provide knowledge about various types of controllers.
6. To facilitate the understanding of PLC program using ladder logic.

COURSE OUTCOME

Upon completion of this course, the students can able to
1. Implement the concepts of sensors and transducers.
2. Design the actuation systems.
3. Develop the controller model for electrical, mechanical and thermal systems.
4. Explain about various types of controllers.
5. Create the PLC program using ladder logic.
6. Design Mechatronic systems.

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 V DESIGN OF MECHATRONICS SYSTEMS


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.
3. To explain basics of SCM and logistics
4. To impart knowledge need for inventory management
5. To expose students to value of information in SCM
6. To understand the concept of information technology involved in SCM

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
6. Get knowledge in information technology involved in 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

COURSE OBJECTIVE
1. To provide knowledge and training in finding optimal solutions under limited resources for the engineering and business problems.
2. To Study and acquire knowledge on engineering and Managerial solutions in Assignment and scheduling problems.
3. To give exposure to inventory in industry.
4. To make the student acquire sound knowledge on sequences to perform operation among various alternatives.
5. To provide an overview of various tools in various sections of industries like marketing, material handling etc.
6. To understand the Engineering and Managerial situations in Transportation.

COURSE OUTCOME
At the end of the course, student will be able to
1. Understand the concepts of Linear programming technique.
2. Apply LPP technique of Transportation models.
3. Understand the techniques of scheduling and sequencing.
4. Acquire knowledge in Inventory control and Queuing theory.
5. Perform network analysis for a project.
6. Understand the concept of replacement models.

UNIT I  INTRODUCTION TO OPERATIONS RESEARCH

UNIT II  TRANSPORTATION PROBLEMS
Least cost method, North west corner rule, Vogel’s approximation method, modified distribution method, unbalance and degeneracy in transportation model, shortest route algorithm – dijkstra algorithm.

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 deterministc 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 AND 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

SUGGESTED READINGS
PROFESSIONAL ELECTIVE V

20BEME7E09 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

3 H – 3 C

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 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 different methods of Locating Jigs and Fixtures and Clamping principles
2. Design and develop jigs
3. Design and development of fixtures for given component
4. Discuss the press working terminologies and elements of cutting dies
5. Distinguish between Bending and Drawing dies.
6. Design Bending and drawing dies

UNIT I PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES

UNIT II JIGS

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

UNIT IV PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAYOUT

UNIT V DESIGN AND DEVELOPMENT OF DIES

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 fuels etc.
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

SUGGESTED READINGS

COURSE OBJECTIVE
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 OUTCOME
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 standard 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.

SUGGESTED READINGS
COURSE OBJECTIVE
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 the 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 OUTCOME
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 the 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 OF SAFETY ENGINEERING
Evolution of modern safety concept - Safety policy - Safety Organization - line and staff functions for safety - Safety Committee - budgeting for safety.

UNIT II   TECHNIQUES OF SAFETY ENGINEERING
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

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. Summarize the concept of Quality
2. Apply Process control for variables
3. Apply the process control for attributes
4. Explain the concept of sampling and to solve problems
5. Explain the concept of Life testing
6. Explain the concept of Reliability and techniques involved

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 \( \sigma \) 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 ACCEPTANCESAMPLING

UNIT IV  LIFE TESTING –RELIABILITY

UNIT V QUALITY AND RELIABILITY

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

SUGGESTED READINGS

WEB REFERENCES
1. https://nptel.ac.in/courses/110105039/
2. https://www.qualitygurus.com
COURSE OBJECTIVES
1. To study the significance of waste heat recovery systems and carry out its economic analysis.
2. To know the concepts of cogeneration, its types and probable areas of applications.
3. To enrich the understanding of thermodynamics, heat transfer, and fluid mechanics principles to design and analysis of the emerging technology.
4. To impart knowledge on operational issues and challenges cogeneration technologies.
5. To understand the impact of this technology in waste heat recovery systems.
6. To introduce the concepts of various systems involved in waste heat recovery process.

COURSE OUTCOMES
The student will be able to
1. Understand the various methods of cogeneration.
2. Apply knowledge of thermodynamics, heat transfer, and fluid mechanics principles to design and analysis of the emerging technology.
3. Have thorough understanding, operational issues and challenges in cogeneration technologies.
4. Understand the impact of this technology in waste heat recovery systems.
5. Get the knowledge over various systems involved in waste heat recovery process.
6. Begin a career as an engineer in an organization, can analyze the economics.

UNIT-I INTRODUCTION

UNIT-II COGENERATION TECHNOLOGIES

UNIT-III ISSUES AND APPLICATIONS OF COGENERATION TECHNOLOGIES

UNIT-IV WASTE HEAT RECOVERY SYSTEMS

UNIT-V ECONOMIC ANALYSIS

SUGGESTED READINGS
COURSE OBJECTIVE
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 OUTCOME
Upon completion of this course, the student can able to
1. Apply the various standards and conventions used in a drawingsheet.
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.

UNIT I  STANDARDS AND CONVENTIONS
Current international standards (ISO) and Indian Standards (IS) - types of lines - principles of presentation - dimensioning - conventional representation of threaded parts, springs, and gears.

UNIT II  DIMENSIONAL AND FORM TOLERANCES
Limits and fits IT system of tolerances, deviation of fit - geometric tolerance-tolerancing of form, orientation, location and runout - datums and Datum systems-Dimensioning and tolerancing of profiles.

UNIT III  MANUFACTURING DRAWINGS
Surface texture indication on drawing - welds symbolic representation of drawings. Given a sub-assembly/assembly to prepare manufacturing drawings of components, Sample exercises on CAD - preparation of manufacturing Drawings.

UNIT IV  RE-DIMENSIONING AND TOLERANCE CHARTING
Introduction to re-dimensioning to suit manufacturing requirements-manufacturing datum-functional datum. Introduction to tolerance charting.

UNIT V  COST ESTIMATION
Preparation of Process chart for a given component - estimation of setting time and machining time-estimation of material cost, labour cost and overhead cost based on supplied data.

SUGGESTED READINGS
COURSE OBJECTIVE

The goal of the course is:
1. To learn various energy storage systems used for Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV).
2. To learn about design and operation of solid-state Li-ion battery.
3. To gain knowledge on the high temperature application of battery.
4. To learn various technologies for recycling used batteries.
5. To understand the battery electrical and thermal management systems using active and passive cooling system.
6. To Analysis battery performance.

COURSE OUTCOME

At the end of the course the student would be able:
1. Understand the performance and driving cycles of EVs.
2. Can apply their knowledge to manufacture various types of Li-ion batteries.
3. Can apply knowledge on use of Li-ion battery in large scale grid and space crafts.
4. Understand Techno-economic aspects of battery recycling and environmental safety.
5. Understand battery cooling system and safety precautions for high voltage battery.

UNIT – I ENERGY STORAGE SYSTEMS

General background on alternative energy sources and sustainability, Introduction to electric-based transportation, Overview of on-road vehicle electrification, EVs configuration, Energy and power requirements for various HEVs and EVs Vehicle performance and driving cycles.

UNIT – II LITHIUM BATTERIES

Li-ion batteries - Principle of operation, Battery components and design Electrode, cell and battery fabrications, Building block cells, battery modules and packs and applications.All solid-state batteries and future developments, Li-Sulphur battery, Li-Air battery, Sodium-battery, Magnesium battery, Aluminium battery, Silicon battery.

UNIT – III HIGH TEMPERATURE BATTERIES FOR BACK-UP APPLICATIONS

Advance Ni-MH batteries for transportation, Future prospects of Ni-MH batteries vs. lithium ion batteries, Zebra cell, Li-iron sulphide cells, Vanadium and iron-based batteries, Semi-fluid flow batteries for large scale grid application, Ni-H2 cells for space applications.

UNIT – IV FUEL CELLS AND BATTERY RECYCLING TECHNOLOGY

Introduction to fuel cells, Proton-exchange membrane and alkaline fuel cells for transportation, Solid oxide fuel cells, Technology and economic aspects of battery recycling, Environmental effect and controlling of poisonous chemicals contamination.

UNIT – V BATTERY MANAGEMENT

Fundamentals of battery management systems and controls, Battery Thermal Management - Passive cooling, Active cooling - Liquids & air systems.
Regulations and Safety Aspects of High Voltage Batteries, Code and Standards, Safe handling of Lithium Batteries, Safety of high voltage battery.

SUGGESTED READINGS


WEB REFERENCES

1. https://nptel.ac.in/courses/108/103/108103009/
OPEN ELECTIVES
COURSES OFFERED BY OTHER DEPARTMENTS

20BESHOE**
SOLIDWASTEMANAGEMENT
3 H – 3 C

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

COURSE OBJECTIVES
1. To make the students conversant with basics of Solid wastes and its classification.
2. To make the student acquire sound knowledge of different treatments of solid wastes.
3. To acquaint the student with concepts of transfers disposals.
4. To develop an understanding of the basic concepts of Hazardous wastemanagements.
5. To acquaint the students with the basics of energy generation from wastematerials.
6. To make the student understand about the disposal and treatment of waste scientifically.

COURSE OUTCOMES
1. Outline the basic principles of Solid waste and separation of wastes
2. Identify the concepts of treatment of solid wastes
3. Identify the methods of wastes disposals.
4. Examine the level of Hazardousness and its management.
5. Examine the possible of the energy production using wastematerials.
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I  SOLID WASTE

UNIT II  WASTE TREATMENT
Size Reduction – Aerobic Composting – Incineration – batch type and continuous flow type, Medical/Pharmaceutical Waste Incineration – Environmental Impacts – Measures of Mitigate Environmental Effects due to Incineration

UNIT III  WASTE DISPOSAL

UNIT IV  HAZARDOUS WASTE MANAGEMENT

UNIT V  ENERGY GENERATION FROM WASTE

SUGGESTED READINGS
COURSE OBJECTIVES
1. To make the students conversant about the green chemistry
2. To make the student acquire sound knowledge of the atom efficient process and synthesis elaborately.
3. To acquaint the student with concepts of green technology.
4. To develop an understanding of the basic concepts of renewable energy resources.
5. To acquaint the students with the basics information on catalysis.
6. To acquaint the students about the green alternate solutions.

COURSE OUTCOMES
1. Outline the basic principles of green chemistry
2. Examine the different atom efficient process and synthesis elaborately
3. Apply the concepts combustion of greentechnology
4. Identify and apply the concepts of renewable energy
5. Apply the concepts of green catalysts in the synthesis
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology

UNIT I   INTRODUCTION TO GREEN CHEMICAL PRINCIPLES
Definition, tools, and twelve principles of green chemistry, solvent-less reactions and reactions in water, microwaves and fluorous solvents, green resolution of racemic mixtures, materials for a sustainable economy, chemistry of longer wear, agrochemicals: problems and green alternate solutions.

UNIT II   ATOM EFFICIENT PROCESSES
Atom efficient processes, evaluating chemical reagents according to their yield and atom efficiency, examples of efficient stoichiometric and catalytic processes, atom economy and homogeneous catalysis, halide-free synthesis and alternatives to Strecker synthesis

UNIT III   BIOTECHNOLOGY AND GREEN CHEMISTRY
Bio technology and its applications in environmental protection-Bio informatics-Bio remediation, biological purification of contaminated air. Green chemistry for clean technology-Significance of green chemistry-Basic components of green chemistry, Industrial applications of green chemistry, green fuels-e-green propellants and bio catalysts.

UNIT IV  RENEWABLE RESOURCES
Use of renewable materials, evaluating feedstock and starting materials and their origins, toxicity, sustainability and the downstream implications of the choice of feedstock, commodity chemicals from glucose and biomass conversion

UNIT V   CATALYSIS IN GREENCHEMISTRY
Catalysis, energy requirements and usage, optimization of the reaction by minimizing the energy requirements, examples of efficient catalytic reactions including the use of heterogeneous catalysis, zeolites, oxidation using molecular oxygen.

SUGGESTED READINGS
COURSE OBJECTIVES
1. To make the students conversant with the information on electrochemical material.
2. To make the student acquire sound knowledge of conducting polymers.
3. To acquaint the student with concepts of Energy storage devices.
4. To develop energy storage devices.
5. To impart knowledge on basic principles of solar cells and its applications.
6. To study about Electro organic chemicals.

COURSE OUTCOMES
1. Outline the basic principles of chemistry in electrochemical material.
2. Examine the properties of conducting polymers.
3. Apply the concepts of electrochemistry in storage devices.
4. Identify the concepts of storage devices and its applications.
5. Apply the suitable materials for the manufacturing of storage devices.
6. Integrate the chemical principles in the projects undertaken in field of engineering and technology.

UNIT I METAL FINISHING

UNIT II CONDUCTING POLYMERS AND ELECTROCHEMICALS
Electropolymerisation- anodic and cathodic polymerization-effect of reaction parameters on the course of the reaction- Electrochemical preparation of conducting polymers-poly acetylene- Electrolytic production of perchlorates and manganese dioxide- Electro organic chemicals- constant current electrolysis.

UNIT III BATTERIES AND POWERSOURCES-I
Principles of energy conservation- electrochemical energy conservation- thermodynamic reversibility, Gibbs equation. EMF- battery terminology, energy and power density- Properties of anodes, cathodes, electrolytes and separators- Types of electrolytes.

UNIT IV BATTERIES AND POWERSOURCES-II
Primary batteries- Dry Leclanche cells, alkaline primary batteries, Lithium batteries- construction, characteristics, problems associated with system- Secondary batteries- Lead acid, nickel cadmium- Fuel cells- Introduction, types of fuel cells, advantages.

UNIT V ELECTROCHEMICAL MATERIALS SCIENCE
Solar cells- Preparation of CdS/Cu2S solar cells by screen printing techniques and their characteristics - Amorphous silicon solar cells - Photo electrochemical cells(PEC) for conversion of light energy to electrical energy - PEC cells based on Cd/Se and Ga/As characteristics.

SUGGESTED READINGS
COURSE OBJECTIVES
1. To understand the basic concepts of electric hybrid vehicle.
2. To gain the knowledge about electric propulsion unit.
3. To gain the concept of Hybrid Electric Drive-Trains.
4. To gain the different Energy Management Strategies.
5. To study about the efficiency manipulation in drives.
6. To understand and gain the knowledge about various energy storage devices.

COURSE OUTCOMES
1. Summarize the basic concepts in bioprocess Engineering.
2. Explain the concept of Hybrid Electric Vehicles.
3. Understand the concept of Hybrid Electric Drive-Trains.
4. Identify the different Energy Management Strategies.
5. Understand the concept of different Energy Storage devices.
6. Analyze the different motor drives used in Hybrid Electric Vehicles.

UNIT I INTRODUCTION
History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT II HYBRID ELECTRIC DRIVE-TRAINS
Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT III ELECTRIC PROPULSION UNIT
Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV ENERGY STORAGE
Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT V ENERGY MANAGEMENT STRATEGIES
Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

SUGGESTED READINGS
1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2010
COURSE OBJECTIVES
1. To gain the knowledge about environmental aspects of energy utilization.
2. To understand the basic principles of wind energy conversion, solar cells, photovoltaic conversion.
3. To study about solar energy collectors and its storages
4. To study about the interconnected system in wind power
5. To understand the basic principles fuel cell, Geothermal power plants.
6. To gain the knowledge about hydro energy.

COURSE OUTCOMES
At the end of this course, students will demonstrate the ability to
1. Analyze the Energy Scenario in India
2. Understand the concept of Solar Energy
3. Understand the concept of Wind Energy
4. Understand the concept of Hydro Energy
5. Analyze the different energy sources
6. Students gathered the real-time interconnected system modelling in wind power

UNIT I  INTRODUCTION

UNIT II  SOLARENERGY
Introduction to solar energy: solar radiation, availability, measurement and estimation - Solar thermal conversion devices and storage - solar cells and photovoltaic conversion - PV systems - MPPT. Applications of PV Systems – solar energy collectors and storage.

UNIT III  WINDENERGY

UNIT IV  HYDROENERGY
Hydropower, classification of hydro power, Turbine selection, Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

UNIT V  OTHERSOURCES
Bio energy and types – Fuel cell, Geo-thermal power plants; Magneto-hydro-dynamic (MHD) energy conversion.

SUGGESTED READINGS
COURSE OBJECTIVES

1. To examine the role and tasks of basic housing policies and building bye laws
2. Understand the process of integrated service delivery in the context of economic, social, environmental and institutional factors
3. Analyze the Innovative construction methods and Materials
4. Analyze city management strategies and strengthen the urban governance through a problem solving approach
5. To know the Importance of basic housing policies and building bye laws
6. To use Housing Programmes and Schemes

COURSE OUTCOMES
Upon completion of this course, the students will be able to
1. Know the Importance of basic housing policies and building bye laws
2. Use Housing Programmes and Schemes
3. Plan and Design of Housing projects
4. Examine Innovative construction methods and Materials
5. Know Housing finance and loan approval procedures
6. Understand Construction as well as managing techniques

UNIT I INTRODUCTION TO HOUSING
Definition of Basic Terms – House, Home, Household, Apartments, Multi storeyed Buildings, Special Buildings, Objectives and Strategies of National Housing Policies, Principle of Sustainable Housing, Housing Laws at State level, Bye-laws at Urban and Rural Local Bodies – levels - Development Control Regulations, Institutions for Housing at National, State and Local levels

UNIT II HOUSING PROGRAMMES
Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighbourhoods, Open Development Plots, Apartments, Rental Housing, Co-operative Housing, Slum Housing Programmes, Role of Public, Private and Non-Government Organisations.

UNIT III PLANNING AND DESIGN OF HOUSING PROJECTS
Formulation of Housing Projects – Site Analysis, Layout Design, Design of Housing Units (Design Problems)

UNIT IV CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS
New Constructions Techniques – Cost Effective Modern Construction Materials, Building Centers – Concept, Functions and Performance Evaluation

UNIT V HOUSING FINANCE AND PROJECT APPRAISAL

SUGGESTED READINGS
2. Francis Cherunilam and Odeyar D Heggrade, Housing in India, Himalaya Publishing House, Bombay, 2001
3. CMA, Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2002
4. UNCHS, National Experiences with Shelter Delivery for the Poorest Groups, UNCHS (Habitat), Nairobi, 2000
COURSE OBJECTIVES
1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings
5. To produce designs using a combination of 2D and 3D software.
6. Get a Detailed study of an engineering artifact.

COURSE OUTCOMES
The students will be able to
1. Develop Parametric design and the conventions of formal engineering drawing
2. Produce and interpret 2D & 3D drawings
3. Communicate a design idea/concept graphically/visually
4. Examine a design critically and with understanding of CAD - The student learn to interpret drawings, and to produce designs using a combination of 2D and 3D software.
5. Get a Detailed study of an engineering artifact
6. Planning and designing of structures

UNIT I
INTRODUCTION
Introduction to concept of drawings, Interpretation of typical drawings, Planning drawings to show information concisely and comprehensively; optimal layout of drawings and Scales; Introduction to computer aided drawing, co-ordinate systems, reference planes. Commands: Initial settings, Drawing aids, Drawing basic entities, Modify commands, Layers, Text and Dimensioning, Blocks. Drawing presentation norms and standards.

UNIT II
SYMBOLS AND SIGN CONVENTIONS
Materials, Architectural, Structural, Electrical and Plumbing symbols. Rebar drawings and structural steel fabrication and connections drawing symbols, welding symbols; dimensioning standards

UNIT III
MASONRY BONDS
English Bond and Flemish Bond – Corner wall and Cross walls - One brick wall and one and half brick wall

UNIT IV
BUILDING DRAWING
Terms, Elements of planning building drawing, Methods of making line drawing and detailed drawing. Site plan, floor plan, elevation and section drawing of small residential buildings. Foundation plan. Roof drainage plans. Depicting joinery, standard fittings & fixtures, finishes. Use of Notes to improve clarity

UNIT V
PICTORIAL VIEW
Principles of isometrics and perspective drawing. Perspective view of building.

List of Drawing Experiments:
1. Buildings with load bearing walls including details of doors and windows.
2. Single storey RCC building
3. Multistorey RCC building

SUGGESTED READINGS
3. Sham Tickoo Swapna D (2009), “AUTOCAD for Engineers and Designers”, Pearson Education
COURSE OBJECTIVES

1. Recognize the properties of the basic industries and the environmental impact of waste generated is able to compare.
2. Define the characteristics of industrial wastewater.
3. Establish a relationship between the properties of industrial wastewater.
4. Explain the principles of industrial wastewater refining.
5. Determine the appropriate treatment methods for textile industry wastewater.
6. Allow the properties of textile industry waste waters

COURSE OUTCOMES

After completion of the course, students are able to

1. Examine the constituents of waste water and its effects.
2. Separate the contaminants from the effluent for treatability.
3. Determine the biomass yield and substrate utilization rate for biological treatment process and design of activated sludge process.
4. Develop a flow sheet for the waste water treatment from dairy, sugar, pulp and paper, textile and pharmaceutical industries.
5. Develop process flow diagram for water reuse and sludge disposal.
6. Students will learn treatment of industrial waste water.

UNIT I INTRODUCTION TO WASTE WATER ENGINEERING

Waste Water Engineering - Overview, inorganic non-metallic constituents and metallic constituents, physical and biological Characteristics.

UNIT II OPERATIONS AND UNIT PROCESS

Screening, Flow Equalization, Mixing, Flocculation, Grit removal, Sedimentation, Coagulation, Precipitation, Oxidation and Neutralization

UNIT III FUNDAMENTALS OF BIOLOGICAL TREATMENT

Introduction, Microbial growth kinetics, types of biological process for wastewater treatment - aerobic and anaerobic oxidation, Biological Nitrification and De-nitrification, biological phosphorous removal, activated sludge process (with design Considerations), trickling filters and lagoons.

UNIT IV WASTE WATER TREATMENT IN SPECIFIC INDUSTRIES


UNIT V WATER REUSE

Wastewater reclamation technologies and reuse, Solid processing flow diagrams, sludge and scum pumping, grinding, screening, degritting, blending, anaerobic digestion, composting, conditioning, dewatering and incineration.

SUGGESTED READINGS

COURSES OFFERED TO OTHER DEPARTMENTS

20BEMEOE01 COMPUTERAIDEDDESIGN 3 H – 3 C

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 apply basic concepts to develop construction (drawing) techniques.
2. To ability to manipulate drawings through editing and plotting techniques.
3. To understand geometric construction and Produce template drawings.
4. To understand and demonstrate dimensioning concepts and techniques.
5. To understand Section and Auxiliary Views.
6. To become familiar with Solid Modelling concepts and techniques.

COURSE OUTCOMES
Upon completion of the course, the students will be able to
1. Apply basic concepts to develop construction (drawing) techniques.
2. Ability to manipulate drawings through editing and plotting techniques.
3. Understand geometric construction and Produce template drawings.
4. Understand and demonstrate dimensioning concepts and techniques
5. Understand Section and Auxiliary Views

UNITI OVERVIEW OF CAD SYSTEMS
Conventional and computer aided design processes-advantages and disadvantages. Subsystems of CAD-CAD hardware and software, analytical and graphics packages, CAD workstations. Networking of CAD systems.

UNITII INTERACTIVE COMPUTER GRAPHICS AND GRAPHICSTRANSFORMATIONS

UNITIII GEOMETRIC MODELING

UNITIV PARAMETRIC DESIGN AND OBJECTREPRESENTATION

UNITV PRODUCT DESIGN ANDDEVELOPMENT
Automated 2D drafting - basics, mating conditions–Types of translators (IGES, STEP, ACIS and DXF). Mass property calculations.

SUGGESTED READINGS
COURSE OBJECTIVES
1. To recognize and evaluate occupational safety and health hazards in the workplace.
2. To determine appropriate hazard controls following the hierarchy of controls.
3. To analyse the effects of workplace exposures, injuries and illnesses, fatalities.
4. To prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
5. To teach students the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
6. To prevent or mitigate harm or damage to people, property, or the environment.

COURSE OUTCOMES
At the end of the course, students will be able to
1. Recognize and evaluate occupational safety and health hazards in the workplace.
2. Determine appropriate hazard controls following the hierarchy of controls.
3. Analyse the effects of workplace exposures, injuries and illnesses, fatalities.
4. Prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
5. Understand the concept of Industrial Safety & provide useful practical knowledge for workplace safety.
6. Prevent or mitigate harm or damage to people, property, or the environment.

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

SUGGESTED READINGS