# CMR ENGINEERING COLLEGE

**(**Approved by AICTE, Affiliated to JNTU, Hyderabad**)**

**MECHANICAL ENGINEERING**

**Applicable From 2020-21 Admitted Batch**

**(AUTONOMOUS R20 REGULATION)**

**I YEAR I SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | MA101BS | Linear Algebra and Calculus | 3 | 1 | 0 | 4 |
| 2 | CH102BS | Engineering Chemistry | 3 | 0 | 0 | 3 |
| 3 | CS103ES | Programming for Problem Solving | 3 | 1 | 0 | 4 |
| 4 | ME104ES | Engineering Graphics | 1 | 0 | 4 | 3 |
| 5 | EN105HS | English | 2 | 0 | 0 | 2 |
| 6 | CH106BS | Engineering Chemistry Lab | 0 | 0 | 3 | 1.5 |
| 7 | CS107ES | Programming for Problem Solving Lab | 0 | 0 | 2 | 1 |
| 8 | EN108HS | English Language and Communication Skills  Lab | 0 | 0 | 3 | 1.5 |
| 9 | MA109BS | Employability skills-I (Aptitude ) | 1 | 1 | 0 | 0 |
|  |  | Induction Programme |  |  |  |  |
| **Total Credits** | | | **13** | **3** | **12** | **20** |

**I YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | MA201BS | Differential Equations and Vector Calculus | 3 | 1 | 0 | 4 |
| 2 | AP202BS | Applied Physics | 3 | 1 | 0 | 4 |
| 3 | CS203ES | Data Structures | 3 | 0 | 0 | 3 |
| 4 | ME208ES | Engineering Mechanics | 3 | 1 | 0 | 4 |
| 5 | ME205ES | Engineering Workshop& IT Workshop | 0 | 0 | 3 | 1.5 |
| 6 | PH206BS | Applied Physics Lab | 0 | 0 | 3 | 1.5 |
| 7 | CS 207ES | Data Structures Lab | 0 | 0 | 2 | 1 |
|  | EN209HS | Employability Skills- II (Business English for Engineers) | 0 | 0 | 2 | 0 |
| **Total Credits** | | | **12** | **3** | **10** | **19** |

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**MECHANICAL ENGINEERING**

**B.Tech. II Year Course Structure**

## II YEAR I SEMESTER

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | ME301PC | Mechanics of Solids | 3 | 1 | 0 | 4 |
| 2 | ME302PC | Material Science and Metallurgy | 3 | 0 | 0 | 3 |
| 3 | MA303BS | Probability and Statistics & Complex  Variables | 3 | 1 | 0 | 4 |
| 4 | ME304PC | Production Technology | 3 | 0 | 0 | 3 |
| 5 | ME305PC | Thermodynamics | 3 | 0 | 0 | 3 |
| 6 | ME306PC | Production Technology Lab | 0 | 0 | 2 | 1 |
| 7 | ME307PC | Computer Aided Machine Drawing Practice | 0 | 0 | 2 | 1 |
| 8 | ME308PC | Material Science & Mechanics of Solids Lab | 0 | 0 | 2 | 1 |
| 9 | \*MC309 | Environmental Science | 2 | 0 | 0 | 0 |
|  | MC310 | Employability Skills-III | 3 | 0 | 0 | 0 |
|  |  | **Total Credits** | **20** | **2** | **6** | **20** |

**II YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | EE401ES | Basic Electrical and Electronics Engineering | 3 | 0 | 0 | 3 |
| 2 | ME402PC | Kinematics of Machinery | 3 | 1 | 0 | 4 |
| 3 | ME403PC | Thermal Engineering-I | 3 | 0 | 0 | 3 |
| 4 | ME404PC | Fluid Mechanics and Hydraulic Machines | 3 | 1 | 0 | 4 |
| 5 | ME405PC | Instrumentation and Control Systems | 3 | 0 | 0 | 3 |
| 6 | EE406ES | Basic Electrical and Electronics Engineering Lab | 0 | 0 | 2 | 1 |
| 7 | ME407PC | Fluid Mechanics and Hydraulic Machines Lab | 0 | 0 | 2 | 1 |
| 8 | ME408PC | Instrumentation and Control Systems Lab. | 0 | 0 | 2 | 1 |
| 9 | \*MC409 | Gender Sensitization Lab | 0 | 0 | 2 | 0 |
|  | MC410 | Employability Skills-IV | 3 | 0 | 0 | 0 |
|  |  | **Total Credits** | **18** | **2** | **8** | **20** |

## \*MC – Satisfactory/Unsatisfactory

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**MECHANICAL ENGINEERING**

**B.Tech. III Year Course Structure**

## III YEAR I SEMESTER

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | SM501MS | Business Economics and Financial Analysis | 3 | 0 | 0 | 3 |
| 2 | ME502PC | Dynamics of Machinery | 3 | 1 | 0 | 4 |
| 3 | ME503PC | Design of Machine Elements-I | 3 | 0 | 0 | 3 |
| 4 | ME504PC | Metrology & Machine Tools | 3 | 0 | 0 | 3 |
| 5 | ME505PC | Thermal Engineering-II | 3 | 0 | 0 | 3 |
| 6 | ME506PC | Operations Research | 3 | 0 | 0 | 3 |
| 7 | ME507PC | Kinematics & Dynamics Lab | 0 | 0 | 2 | 1 |
| 8 | ME508PC | Metrology & Machine Tools Lab | 0 | 0 | 2 | 1 |
| 9 | ME509PC | Thermal Engineering Lab | 0 | 0 | 2 | 1 |
| 10 | \*MC509 | Constitution of India | 3 | 0 | 0 | 0 |
|  | \*MC511 | Cyber Security | 3 | 0 | 0 | 0 |
|  |  | **Total Credits** | **24** | **1** | **6** | **22** |

1. **YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | ME601PC | Design of Machine Elements-II | 3 | 0 | 0 | 3 |
| 2 | ME602PC | Heat Transfer | 3 | 1 | 0 | 4 |
| 3 | ME603PC | Finite Element Methods | 3 | 0 | 0 | 3 |
|  | ME604PC | CAD & CAM | 3 | 0 | 0 | 3 |
| 4 |  | **Professional Elective-I** | 3 | 0 | 0 | 3 |
| 5 |  | **Open Elective-I / MOOCs** | 3 | 0 | 0 | 3 |
| 6 | ME605PC | Heat Transfer Lab | 0 | 0 | 2 | 1 |
| 7 | ME606PC | CAD & CAM LAB | 0 | 0 | 2 | 1 |
| 8 | EN606HS | Advanced Communication Skills Lab | 0 | 0 | 2 | 1 |
| 9 | \*MC609 | Intellectual Property Rights | 3 | 0 | 0 | 0 |
|  | \*MC611 | Artificial Intelligence | 3 | 0 | 0 | 0 |
|  |  | **Total Credits** | **24** | **1** | **6** | **22** |

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**MECHANICAL ENGINEERING**

**B.Tech. IV Year Course Structure**

## YEAR I SEMESTER

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | ME701PC | Refrigeration and Air Conditioning | 3 | 0 | 0 | 3 |
| 2 |  | **Professional Elective-II** | 3 | 0 | 0 | 3 |
| 3 |  | **Professional Elective-III** | 3 | 0 | 0 | 3 |
| 4 |  | **Professional Elective-IV** | 3 | 0 | 0 | 3 |
| 5 |  | **Open Elective-II / MOOCs** | 3 | 0 | 0 | 3 |
| 6 | ME702PC | Industry Oriented Mini Project | 0 | 0 | 4 | 2 |
| 7 | ME703PC | Seminar | 0 | 0 | 2 | 1 |
| 8 | ME704PC | Project Stage- I | 0 | 0 | 6 | 3 |
|  |  | **Total Credits** | 15 | 0 | 12 | **21** |

**IV YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 |  | **Professional Elective-V** | 3 | 0 | 0 | 3 |
| 2 |  | **Professional Elective-VI** | 3 | 0 | 0 | 3 |
| 3 |  | **Open Elective-III / MOOCs** | 3 | 0 | 0 | 3 |
| 4 | ME802PC | Project Stage- II | 0 | 0 | 14 | 7 |
|  |  | **Total Credits** | 9 | 0 | 14 | **16** |

**List of Professional Electives to be offered**

## Professional Elective – I

|  |  |
| --- | --- |
| ME511PE | Unconventional Machining Processes |
| ME512PE | Machine Tool Design |
| ME513PE | Production Planning and Control |

**Professional Elective – II**

|  |  |
| --- | --- |
| ME621PE | Industrial Management |
| ME622PE | Additive Manufacturing |
| ME623PE | Engineering Tribology |

## Professional Elective – III

|  |  |
| --- | --- |
| ME731PE | Power Plant Engineering |
| ME732PE | Automobile Engineering |
| ME733PE | Robotics |

**Professional Elective – IV**

|  |  |
| --- | --- |
| ME741 PE | Renewable Energy Sources |
| ME742PE | Computational Fluid Dynamics |
| ME743PE | Mechanical Vibrations |

## Professional Elective – V

|  |  |
| --- | --- |
| ME851PE | CNC Technology |
| ME852PE | Automation in Manufacturing |
| ME853PE | Turbo Machinery |

**Professional Elective – VI**

|  |  |
| --- | --- |
| ME861PE | Plant Layout & Material Handling |
| ME862PE | Composite Materials |
| ME863PE | Fluid Power System |

## List of Open Electives to be offered

**Open Elective-I**

|  |  |  |
| --- | --- | --- |
| 1 | ME611OE | Industrial Robotics |
| 2 | ME612OE | Non-Conventional Sources of Energy |
| 3 | ME613OE | Basic Mechanical Engineering |

## Open Elective-II

|  |  |  |
| --- | --- | --- |
| 1 | ME721OE | Operations Research |
| 2 | ME722OE | Total Quality Management |
| 3 | ME723OE | Measuring Instruments |

**Open Elective-III**

|  |  |  |
| --- | --- | --- |
| 1 | ME831OE | Principles of Entrepreneurship |
| 2 | ME832OE | Engineering Materials |
| 3 | ME833OE | Linear and Non-Linear Optimization Techniques |

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## MECHANICAL ENGINEERING

**B.Tech. I Year Course Structure**

## (AUTONOMOUS R20 REGULATION)

**I YEAR I SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | MA101BS | Linear Algebra and Calculus | 3 | 1 | 0 | 4 |
| 2 | CH102BS | Engineering Chemistry | 3 | 0 | 0 | 3 |
| 3 | CS103ES | Programming for Problem Solving | 3 | 1 | 0 | 4 |
| 4 | ME104ES | Engineering Graphics | 1 | 0 | 4 | 3 |
| 5 | EN105HS | English | 2 | 0 | 0 | 2 |
| 6 | CH106BS | Engineering Chemistry Lab | 0 | 0 | 3 | 1.5 |
| 7 | CS107ES | Programming for Problem Solving Lab | 0 | 0 | 2 | 1 |
| 8 | EN108HS | English Language and Communication Skills  Lab | 0 | 0 | 3 | 1.5 |
| 9 | MA109BS | Employability skills-I (Aptitude ) | 1 | 1 | 0 | 0 |
|  |  | Induction Programme |  |  |  |  |
| **Total Credits** | | | **13** | **3** | **12** | **20** |

## I YEAR II SEMESTER

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | MA201BS | Differential Equations and Vector Calculus | 3 | 1 | 0 | 4 |
| 2 | AP202BS | Applied Physics | 3 | 1 | 0 | 4 |
| 3 | CS203ES | Data Structures | 3 | 0 | 0 | 3 |
| 4 | ME208ES | Engineering Mechanics | 3 | 1 | 0 | 4 |
| 5 | ME205ES | Engineering Workshop& IT Workshop | 0 | 0 | 3 | 1.5 |
| 6 | PH206BS | Applied Physics Lab | 0 | 0 | 3 | 1.5 |
| 7 | CS 207ES | Data Structures Lab | 0 | 0 | 2 | 1 |
|  | EN209HS | Employability Skills- II (Business English for Engineers) | 0 | 0 | 2 | 0 |
| **Total Credits** | | | **12** | **3** | **10** | **19** |

B-Tech I Year Syllabus

## MA101BS: LINEAR ALGEBRA AND CALCULUS

**(Common for ECE, IT, CSE, CSM, CSD, CSC, ME)**

**L T P C 3 1 0 4**

**Course Objectives**: To learn

* Types of matrices and their properties
* Concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
* Concept of Eigen values and eigenvectors and to reduce the quadratic form to canonical form.Concept of Sequence.
* Concept of nature of the series.
* Geometrical approach to the mean value theorems and their application to the mathematical problems
* Evaluation of improper integrals using Beta and Gamma functions.
* Partial differentiation, concept of total derivative
* Finding maxima and minima of function of two and three variables

**Course Outcomes:** After learning the contents of this paper the student must be able to

* Write the matrix representation of a set of linear equations and to analyze the solution of the System of equations
* Find the Eigen values and Eigen vectors
* Reduce the quadratic form to canonical form using orthogonal transformations.
* Analyze the nature of sequence and series.
* Solve the applications on the mean value theorems.
* Evaluate the improper integrals using Beta and Gamma functions.
* Find the extreme values of functions of two variables with/ without constraints

### UNIT-I: Matrices

Matrices: Types of Matrices, Symmetric; Hermitian; Skew-symmetric; Skew-Hermitian; orthogonal matrices; Unitary Matrices; rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method; System of linear equations; solving system of Homogeneous and Non- Homogeneous equations. Gauss elimination method; Gauss Seidel Iteration Method.

### UNIT-II: Eigen values and Eigen vectors

Linear Transformation and Orthogonal Transformation: Eigen values and Eigenvectors and their properties: Diagonalization of a matrix; Cayley-Hamilton Theorem (without proof); finding inverse and power of a matrix by Cayley-Hamilton Theorem; Quadratic forms and Nature of the Quadratic Forms; Reduction of Quadratic form to canonical forms by Orthogonal Transformation

### UNIT-III: Sequences & Series

Sequence: Definition of a Sequence, limit; Convergent, Divergent and Oscillatory sequences. Series: Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert’s ratio test; Raabe’s test; Cauchy’s Integral test; Cauchy’s root test; logarithmic test. Alternating series: Leibnitz test; Alternating Convergent series: Absolute and Conditionally Convergence.

### UNIT-IV: Calculus:

Mean value theorems: Rolle’s Theorem, Lagrange’s Mean value theorem with their Geometrical Interpretation and applications, Cauchy’s mean value Theorem. Taylor’s Series. Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates), Definition of Improper Integral: Beta and Gamma functions and their applications.

### UNIT-V: Multivariable calculus (Partial Differentiation and applications)

Partial Differentiation; Euler’s Theorem; Total derivative; Jacobian; Functional dependence independence, Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

TEXTBOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition,Pearson, Reprint, 2002.

REFERENCES:

* 1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
  2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11thReprint, 2010

**CH-102BS: ENGINEERING CHEMISTRY**

#### (Common for ECE, CSM, ME )

**B.Tech. I Year I/II Sem L T P C**

**3 0 0 3**

## UNIT-I

**Water and its treatment**

Introduction – hardness of water – causes of hardness – types of hardness: temporary and permanent – expression and units of hardness – Estimation of hardness of water by complex metric method. Numerical problems. Boiler troubles: Sludges, scales and Caustic embrittlement Boiler feed water and its treatment –Internal treatment(Calgon conditioning, Phosphate conditioning and Colloidal conditioning). External Treatment- Softening of water by ion exchange processes. **Potable water** – specifications, steps involved in the treatment of potable water - Disinfection of potable water by chlorination and Ozonization Desalination of water – Reverse osmosis.

## UNIT-II

### Molecular structure and Theories of Bonding: Atomic and Molecular orbital’s

Linear Combination of Atomic Orbital’s (LCAO), molecular orbital of diatomic molecules, molecular energy level diagram of N2, O2, and F2 molecules**.** π-molecular orbital’s of butadiene and benzene.

Crystal Field Theory (CFT): Salient Features of CFT- Crystal Field Splitting of Transition metal ion d-orbital’s in Tetrahedral, Octahedral and square planar geometries. Band structure of solids and effect of doping on conductance.

### UNIT III

**Electrochemistry & Batteries**

Electrochemistry: Electrochemical cells: Daniel cell – cell notation, cell reaction and cell EMF – Numerical problems. Electrochemical series and its applications- Nernst equation . Construction and functioning of Standard hydrogen electrode, calomel electrode, Quinhydrone and glass electrode. Determination of pH of a solution by using Quinhydrone and glass electrode.

Batteries: Primary (Lithium cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery). Fuel cells: Hydrogen–Oxygen fuel cell, Methanol-Oxygen fuel cell ,Advantages and Applications.

### UNIT IV

**Fuels and Combustions**

Classification – solid fuels: coal – analysis of coal - proximate and ultimate analysis and their significance. Liquid fuels – petroleum and its refining – cracking – types – fixed bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol, Fischer-Tropsch’s process.

Gaseous fuels - constituents, characteristics and applications of natural gas, LPG and CNG. Analysis of flue gas by Orsat’s apparatus – Numerical Problems.

Combustion – Definition, Calorific value of fuel – HCV, LCV; Determination of calorific value by Junker’s gas calorimeter – theoretical calculation of Calorific value by Dulong’s formula – Numerical problems on combustion.

### UNIT V

**Engineering Materials and Corrosion**

Polymers: Introduction, classification and mechanism of polymerization- Addition (Free radical polymerization mechanism and Condensation polymerization. Classification of polymers - Thermoplastics & Thermosetting resins. Types of Polymerization of polymers (i) Addition (ii) Condensation (iii) Co-Polymerization.

Preparation, properties and engineering application of PVC, Teflon and Bakelite. Fibers- characteristics of fibers

– preparation, properties and uses of Nylon – 6,6 and Dacron – Fiber Reinforced Plastics (FRP) Glass Fibres – applications. Rubber – Natural rubber and its vulcanization. Synthetic Elastomers- Buna S, Butyl rubber and Thiokol Rubber.

Conducting polymers: Introduction, classification and mechanism of conduction in Poly-acetylene, applications of conducting polymers. Biodegradable polymers: Introduction preparation, properties and applications of poly lactic acid

Corrosion: Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of

electrochemical corrosion, Types of wet corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion- nature of metal and nature of environment– Corrosion control methods – Cathod ic protection (sacrificial anodic and impressed current). Surface coatings: Metallic coatings & methods of application of metallic coatings - hot dipping (galvanization & tinning), metal cladding, Electro less plating ( Ni plating)

### TEXT BOOKS

1. Engineering Chemistry by P.C Jain and M.Jain, Dhanpatrai Publishing Company, New Delhi 2010.
2. Engineering Chemistry by PrasantaRath,B. Rama Devi, Ch.Venkata Ramana Reddy and subhendu Chakroborty, Cengage learning, New Delhi. 2019.
3. Physical Chemistry, by P.W. Atkins

### REFERENCE BOOKS

1. Engineering Chemistry by B. Siva Shankar Mc.Graw Hill Publishing Company Limited, New Delhi 3rd, 2015
2. Text Book of Engineering Chemistry by S.S. Dara &Mukkati S. Chand &Co Publishers, New Delhi (2010)

# CS103ES: PROGRAMMING FOR PROBLEM SOLVING

**(Common for ECE, IT, CSE, CSM, CSD, CSC, ME)**

**B.Tech. I Year II Sem L T P C**

**3 1 0 4**

## Course Objectives:

* To learn the fundamentals of computers.
* To understand the various steps in program development.
* To learn the syntax and semantics of C programming language.
* To learn the usage of structured programming approach in solving problems.

**Course Outcomes:** The student will learn

* To write algorithms and to draw flowcharts for solving problems.
* To convert the algorithms/flowcharts to C programs.
* To code and test a given logic in C programming language.
* To decompose a problem into functions and to develop modular reusable code.
* To use arrays, pointers, strings and structures to write C programs.
* Searching and sorting problems.

## Unit - 1: Introduction to Programming

Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, compilers, creating, compiling and executing a program etc., Number systems. Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples Program design and structured programming.IntroductiontoCProgrammingLanguage:variables(withdatatypesandspacerequir ements), Syntax and Logical Errors in compilation, object and executable code , Operators, expressions and precedence, Expression evaluation type conversion, The Bitwise operations: Bitwise AND, OR, XOR and NOT operators

Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do- while /O: Simple input and output with scanf and printf, formatted I/O, Introduction to stdin, stdout and stderr.

## Unit - II: Functions and Arrays, Strings:

Functions: Designing structured programs, Declaring a function, Signature of a function, Parametersandreturntypeofafunction,passingparameterstofunctions,callbyvalue,Passing arrays to functions, passing pointers to functions, idea of call by reference, Some C standard functions and libraries Recursion: Simple programs, such as Finding Factorial, Fibonacci series etc., Limitations of Recursive functions, Applications of Recursive Functions(Towers of Honoi).

Storage classes (auto, extern, static and register),

Dynamic memory allocation: Allocating and freeing memory, Allocating memory for arrays of different data types.

## Arrays, Strings:

Arrays: one and two dimensional arrays, creating, accessing and manipulating elements of arrays

Strings: Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of strings.

## Unit-III: Pointers, Structures:

Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self- referential structures, usage of self referential structures in linked list (no implementation),Enumeration data type. Defining structures, initializing structures, unions, Array of structures.

## Unit - IV: Preprocessor and File handling in C:

Preprocessor: Commonly used Preprocessor commands like include, define, undef, if, ifdef, ifndef,Commandlinearguments.Files:TextandBinaryfiles,CreatingandReadingandwritingtext andbinaryfiles,Appending data to existing files, Writing and reading structures using binary files, Random access using fseek, ftell and rewind functions.

## Unit - V: Introduction to Algorithms:

Algorithms for finding roots of quadratic equations, finding minimum and maximum numbers of a given set, finding if a number is prime number, etc. Basic searching in an array of elements (linear and binary search techniques) Basic algorithms to sort array of elements (Bubble, Insertion and Selection sort algorithms), Divide & Conquer Algorithms: Quick Sort, Merge Sort.

## TEXT BOOKS:

1. Byron Gottfried, Schaum’s Outline of Programming with C, McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and Data Structures,Cengage Learning, (3rdEdition)

## REFERENCE BOOKS:

1. BrianW.Kernighan andDennis M.Ritchie,TheCProgrammingLanguage,Prentice
2. Hall ofIndia
3. R.G. Dromey, How to solve it by Computer, Pearson (16thImpression)
4. Programming in C, Stephen G. Kochan, Fourth Edition, PearsonEducation.
5. Herbert Schildt, C: The Complete Reference, McGrawHill, 4thEdition.

## ME104ES: ENGINEERING GRAPHICS

**(Common for ECE, CSM, ME )**

## B.Tech. I Year I Sem. L T P C

**1 0 4 3**

## Course Objectives:

* To provide basic concepts in engineering drawing.
* To impart knowledge about standard principles of orthographic projection of objects.
* To draw sectional views and pictorial views of solids

**Course Outcomes:** At the end of the course, the student will be able to:

* Preparing working drawings to communicate the ideas and information.
* Read, understand and interpret engineering drawings.
* Estimate different projections of lines, planes, solids and sectional views
* Able to sketch two-dimensional orthographic drawings and three- dimensional isometric views
* Create and modify two-dimensional orthographic drawings using AutoCAD software

## UNIT – I

**Introduction to Engineering Drawing:** Principles of Engineering Graphics and their Significance, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloids and Hypocycloid, Scales – Plain & Diagonal.

## UNIT- II

**Orthographic Projections:** Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures.— Auxiliary Planes.

## UNIT – III

Projections of Regular Solids – Auxiliary Views - Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views – Sections of Sphere

## UNIT – IV

Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone, Intersection of Solids: Intersection of – Prism vs Prism- Cylinder Vs Cylinder

## UNIT – V

**Isometric Projections:** Principles of Isometric Projection – Isometric Scale – Isometric

Views–Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts. Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions

## Introduction to CAD:

Introduction to CAD Software Package Commands.- Free Hand Sketches of 2D- Creation of 2D Sketches by CAD Package

## TEXTBOOKS:

1. Engineering Drawing N.D. Bhatt/Charotar
2. Engineering Drawing / N. S. Parthasarathy and VelaMurali/Oxford

## REFERENCE BOOKS:

1. Engineering Drawing / Basant Agrawal and McAgrawal/McGrawHill
2. Engineering Drawing/ M. B. Shah, B.C. Rane/Pearson.
3. Computer Aided Engineering Drawing – K Balaveera Reddy et al –CBSPublishers
4. Engineering Drawing and Graphics / K.Venugopal/ New AgeInternational Publishers
5. Engineering Drawing / K.L.Narayana,P.kannaiah/SCITECH

## EN105HS: ENGLISH

#### (Common for ECE, CSM, ME )

**B.Tech. I Year ISem. L T P C**

## 2 0 0 2

**INTRODUCTION**

* In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic, communicative and critical thinking competencies of Engineering students.
* In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts leading to reading comprehension and different passages may be given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind, for example, newspaper articles, advertisements, promotional material etc. *The focus in this syllabus is on skill development, fostering ideas and practice of language skills in various contexts and cultures.*

**Learning Objectives:** The course will help to

* Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
* Equip students to study academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
* Develop study skills and communication skills in formal and informal situations.

**Course Outcomes:** Students should be able to

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

## UNIT –I

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

**Vocabulary Building**: The Concept of Word Formation --The Use of Prefixes and Suffixes. **Grammar:** Identifying Common Errors in Writing with Reference to Articles

and Prepositions.

**Reading:** Reading and Its Importance- Techniques for Effective Reading.

**Writing:** Paragraph writing– Types, Features of a Paragraph - Creating Coherence- Organizing Principles of Paragraphs in Documents. Importance of Proper Punctuation

# UNIT –II

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

**Vocabulary:** Synonyms and Antonyms, Idioms and Phrases.

**Grammar:** Identifying Common Errors in Writing with Reference to Noun- pronoun Agreement and Subject-verb Agreement.

**Reading:** Improving Reading Comprehension Skills–Techniques for Good Comprehension

**Writing:** Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, and Job Application with Resume.

# UNIT –III

**‘Blue Jeans’** from the prescribed textbook ‘English for Engineers’ published by Cambridge University Press.

**Vocabulary**: Odd words, one word substitution

**Grammar:** Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

**Reading:** Sub-skills of Reading- Skimming, Scanning

**Writing**: Defining- Describing Objects, Places and Events – Classifying- Providing Examples or Evidence

# UNIT –IV

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

**Vocabulary**: Standard Abbreviations in English, Verbal Analogy

**Grammar:** Redundancies in Oral and Written Communication, Tag questions **Reading**: Comprehension**-** Intensive Reading and Extensive Reading **Writing:** Writing Practices- Essay Writing, Précis Writing.

# UNIT –V

**‘Mokshagundam Visvesvaraya’** from the prescribed text book by JNTUH ‘Epitome of Wisdom’ – Maruthi Publications.

**Vocabulary**: Technical Vocabulary and their usage

**Grammar:** Error identification

**Reading: “If Poem”** by Rudyard Klipling

**Writing:** Creative writing- Advertisement making, Poster preparation, Technical Reports- Characteristics of a Report Writing,

**PRESCRIBED TEXTBOOK:**

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

## REFERENCES:

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P(2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007).Remedial English Grammar, Macmillan.
4. Zinsser, William. (2001). On Writing Well. HarperResourceBook.
5. Hamp-Lyons, L. (2006) Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press.

# CH106BS - Engineering Chemistry Lab

**(Common for ECE, CSM, ME )**

**B.Tech. I Year I/II Sem. L T P C**

**0 0 3 1.5**

## LIST OF EXPERIMENTS: (PERFORM ANY 10 EXPERIMENTS)

**Volumetric Analysis:**

**Experiment No. 1:** Determination total hardness of water by complexometric method using EDTA.

**Experiment No 2:** Estimation of ferrous iron in the given solution by permanganometry.

**Experiment No 3:** Estimation of amount of chloride in water.

## Analysis of Coal

**Experiment No 4:** Determination of moisture content in the given coal sample

## Conductometry:

**Experiment No 5:** Estimation of HCl by Conductometric titrations

**Experiment No 6:** Estimation of Acetic acid by Conductometric titrations

## Potentiometry:

**Experiment No 7:** Estimation of Ferrous iron by Potentiometry using dichromate

**Experiment No 8:** Estimation of HCl by Potentiometry using NaOH

## pHMetry:

**Experiment No 9:** Estimation of HCl by PhMetry using NaOH

## Colorimetry:

**Experiment No 10: E**stimation of Manganese by Colorimetry.

## Preparation:

**Experiment No 11:** Preparation of Bakelite.

**Experiment No 12:** Preparation of Thiokol Rubber.

## TEXT BOOKS

1. J. Mendham and Thomas ,”Vogel’ s text book of quantitative chemical analysis”, Pearson education Pvt.Ltd. New Delhi ,6th ed. 2002.

## SUGGESTED READINGS

1. Dr. Subdharani , “Laboratory Manual on Engineering Chemistry”, DhanpatRai Publishing, 2012.
2. S.S. Dara , “A Textbook on experiment and calculation in engineering chemistry”, S.Chand and Company, 9th revised edition, 2015.

# CS107ES: PROGRAMMING FOR PROBLEM SOLVINGLAB

**(Common for ECE, IT, CSE, CSM, CSD, CSC, ME)**

**B.Tech. I Year II Sem. L T P C**

**0 0 3 1.5**

[Note: The programs may be executed using any available Open Source/ Freely available IDE Some of the Tools available are:

CodeLite: <https://codelite.org/> Code::Blocks:

<http://www.codeblocks.org/>

DevCpp :<http://www.bloodshed.net/devcpp.html> Eclipse: [http://www.eclipse.org](http://www.eclipse.org/)

This list is not exhaustive and is NOT in any order of preference*]*

**Course Objectives:** The students will learn the following:

* To work with an IDE to create, edit, compile, run and debug programs
* To analyze the various steps in program development.
* To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc.
* To develop modular, reusable and readable C Programs using the concepts like functions, arrays etc.
* To Write programs using the Dynamic Memory Allocation concept.
* To create, read from and write to text and binary files

**Course Outcomes:** The candidate is expected to be able to:

* formulate the algorithms for simple problems
* translate given algorithms to a working and correct program
* correct syntax errors as reported by the compilers
* identify and correct logical errors encountered during execution
* represent and manipulate data with arrays, strings and structures
* use pointers of different types
* create, read and write to and from simple text and binary files
* modularize the code with functions so that they can be reused

# Practice sessions:

1. Write a simple program that prints the results of all the operators available in C (includingpre/postincrement,bitwiseand/or/not,etc.).Readrequiredoperandvalues from standard input.
2. Write a simple program that converts one given data type to another using auto conversion and casting. Take the values form standard input.

# Simple numeric problems:

1. Write a program for find the max and min from the three numbers.
2. Write the program for the simple, compound interest.
3. Write program that declares Class awarded for a given percentage of marks, where mark <40%= Failed, 40% to <60% = Second class, 60% to <70%=First class,

>=70%

= Distinction. Read percentage from standard input.

1. Write a program that prints a multiplication table for a given number and the number of rows in the table. For example, for a number 5 and rows = 3, the output should be

e. 5 x 1 = 5

f. 5 x 2 =10

g. 5 x 3 =15

h. Write a program that shows the binary equivalent of a given positive number between 0 to 255.

# Expression Evaluation:

1. A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula s = ut+(1/2)at^2 where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8m/s^2)).
2. Write a C program, which takes two integer operands and one operator from the user, performstheoperationandthenprintstheresult.(Considertheoperators+,-,\*,/,%and use Switch Statement)
3. Write a program that finds if a given number is a prime number
4. Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
5. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of these quence.
6. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
7. Write a C program to find the roots of a Quadratic equation.
8. Write a C program to calculate the following, where x is a fractional
   1. value.

i. 1-x/2+x^2/4-x^3/6

1. Write a C program to read in two numbers, x and n, and then compute the sum
   1. of this geometricprogression:1+x+x^2+x^3+…+x^n. For example: if n is 3
2. And xis5, then the program computes 1+5+25+125.

# Arrays and Pointers and Functions:

* 1. Write a C program to find the minimum, maximum and average in an array of integers.
  2. Write a C program that uses functions to perform the following: i. Addition of Two Matrices
     1. Multiplication of Two Matrices
     2. Transpose of a matrix with memory dynamically allocated for the new matrixes row and column counts may not be same.
  3. Write C programs that use both recursive and non-recursive functions I To find the factorial of a given integer.
     1. To find the GCD (greatest common divisor) of two given integers.
     2. To find x^niv. Towers of Honoi.
  4. Write a program for reading elements using pointer into array and display the values using array.
  5. Write a program for display values reverse order from array using pointer.
  6. Write a program through pointer variable to sum of n elements from array.

# Files:

1. Write a C program to display the contents of a file to standard output device.
2. Write a C program which copies one file to another, replacing all lowercase characters with their upper case equivalents.
3. Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command line arguments.
4. Write a C program that does the following:

It should first create a binary file and store 10 integers, where the file name and 10 values are given in the command line. (hint: convert the strings using a toi function) Now the program asks for an in and a value from the user and the value at that index should be changed to the new value in the file.

(hint: use seek function The program should then read all 10 values and print them back.

1. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file).

# Strings:

1. Write a C program to convert a Roman numeral ranging from I to L to its decimal equivalent.
2. Write a C program that uses functions to perform the following operations: i.To insert a sub-string in to a given main string from a given position.

ii. To delete n Characters from a given position in a given string.

1. Write a C program to determine if the given string is a palindromeornot(Spelled same in both directions with or without a meaning like madam, civic, noon, abcba,etc.)
2. Write a C program that displays the position of a character ch in the string S or – 1if S doesn‘t contain ch.
3. Write a C program to count the lines, words and characters in a given text.

# Miscellaneous:

1. Write a menu driven C program that allows a user to enter n numbers and then choose between finding the smallest, largest, sum, or average. The menu and all the choices are to be functions. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.
2. Write a C program to construct a pyramid of numbers as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1  1 2  1 2 3 | \*  \* \*  \* \* \* | 1  2 3  4 5 6 | 1  2 2  3 3 3  4 4 4 4 | \*  \* \*  \* \* \*  \* \*  \* |

# Sorting and Searching:

1. Write a C program that uses non recursive function to search for a Key value in a given list of integers using linear search method.
2. Write a C program that uses non recursive function to search for a Key value in a given sorted list of integers using binary search method.
3. Write a C program that implements the Bubble sort method to sort a given list of Integers in ascending order.
4. Write a C program that sorts the given array of integers using election sort in descending order.
5. Write a C program that sorts the given array of integers using in sertion sort in ascending order
6. Write a C program that sorts the given array of integers using Merge sort in ascending order.
7. Write a C program that sorts the given array of integers using Quick sort in ascending order

**Suggested Reference Books for solving the problems:**

1. Byron Gottfried, Schaum’s Outline of Programming with C,McGraw-Hill
2. B.A. Forouzan and R.F. Gilberg C Programming and DataStructures, Cengage Learning, (3rdEdition)
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language,Prentice
4. Hall of India
5. R.G. Dromey, How to solve it by Computer, Pearson (16thImpression)
6. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
7. Herbert Schildt, C: The Complete Reference, McGrawHill, 4thEdition

# EN108HS: ENGLISH LANGUAGE AND COMMUNICATION SKILS LAB

#### (Common for ECE, CSM, ME)

**B.Tech I Year I Sem. L T P C**

**0 0 3 1.5**

The **Language Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

# Course Objectives:

* To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
* To sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm
* To bring about a consistent accent and intelligibility in students’ pronunciation of English by providing an opportunity for practice in speaking
* To improve the fluency of students in spoken English and neutralize their mother tongue influence
* To train students to use language appropriately for public speaking and interviews

**Learning Outcomes:** Students will be able to attain

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

# Syllabus:

English Language and Communication Skills Lab (ELCS) shall have two parts:

1. Computer Assisted Language Learning(CALL)Lab
2. Interactive Communication Skills(ICS)Lab

# Listening Skills

Objectives

1. To enable students develop their listening skills so that they may appreciate its role in the LSRW skills approach to language and improve their pronunciation
2. To equip students with necessary training in listening so that they can comprehend the speech of people of different backgrounds and regions

*Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.*

* + Listening for general content
  + Listening to fill up information
  + Intensive listening
  + Listening for specific information

# Speaking Skills

Objectives

1. To involve students in speaking activities in various contexts
2. To enable students express themselves fluently and appropriately in social and professional contexts
   * Oral practice: Just A Minute (JAM)Sessions
   * Describing objects/situations/people
   * Role play – Individual/Group activities

**Exercise – I**

**CALL Lab**: Introduction to Phonetics – Speech Sounds – Vowels and Consonants.

**ICS Lab**: Ice-Breaking Activity and JAM Session

## Exercise – II

**CALL Lab**: Structure of Syllables – Past Tense Marker and Plural Marker, Weak Forms and Strong Forms.

**ICS Lab:** Situational Dialogues – Role Play- Expressions in Various Situations –Making Requests and Seeking Permissions – Telephone Etiquette.

## Exercise - III

**CALL Lab:** Minimal Pairs- Word Accent and Stress Shifts.

**ICS Lab**: How to make Formal Presentations.

**Exercise –IV**

**CALL Lab**: Listening for General Details, Intonation and Common Errors in Pronunciation.

**ICS Lab**: Public Speaking- Making a Short Speech – Extempore.

Exercise – V

**CALL Lab:** Listening for Specific Details, Neutralization of Mother Tongue Influence and Conversation Practice

**ICS Lab**: Interview Skills*.* Mock Interviews.

## Minimum Requirement of infrastructural facilities for ELCS Lab:

### Computer Assisted Language Learning(CALL)Lab:

**The Computer Assisted Language Learning Lab** has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students.

### System Requirement (Hardware component):

*Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:*

* 1. Computers with Suitable Configuration
  2. High Fidelity Headphones

## 1. Interactive Communication Skills (ICS)Lab:

**The Interactive Communication Skills Lab:** A Spacious room with movable chairs and audio-visual aids with a Public-Address System, a LCD and a projector etc.

## MA109BS: Aptitude

#### (Common for ECE, CSM, ME)

**B.Tech. I YearI/II Sem. L T P C**

**1 1 0 0**

# Course Objectives:

To enhance the problem solving skills, to improve the basic mathematical skills and to help students who are preparing for any type of competitive examinations.

# Course Outcomes:

Students will be expected to actively do mathematics such as analyzing data, constructing hypothesis, solving problems, reflecting on their work, and making connections. The Quantitative techniques is organized around big mathematical and statistical concepts.

**Unit-1:**

**H.C.F & L.C.M:** Division Method, Factorization method, H.C.F.& L.C.M. of fractions.

**Averages:** Arithmetic mean, Geometric mean, Harmonic mean.

**Ages:** using algebraic equations.

**Percentages:** Percentage difference, Percentage increase & decrease, fraction to Percentage, Percentage vs per cent.

## Unit-2:

**Profit & Loss:** Cost price, selling price, percentages of profit & loss. **Partnerships:** definition, Ratio of division of gains, working and sleeping partners. **Simple & compound interest:** Principal amount, interest, time & rate of interest.

## Unit-3:

**Time & Work:** Introduction, time & work by using fractions and percentages, negative work.

**Pipes & Cisterns:** Inlet, Outlet, time to emptying & filling a tank.

## Unit-4:

**Time & Distance:** Time, speed, Average and Distance related problems.

**Boats & Streams:** Upstream, down stream, still water, stream related problems.average speed, distance, speed when time is given.

**Trains:** pass a point, Stationary object of length, moving objects same & opposite directions.

## Unit-5:

**Permutations & Combinations:** Definitions, permutations with repetitions allowed & not allowed, rank of dictionary words.

**Probability:** Basic definitions, axioms, addition theorem, conditional probability, multiplication theorem, total probability theorem, Bayes’ theorem.

## TEXTBOOK:

1. Quantitative aptitude by Dr.R.S.Aggarwal, S.Chand publications.

## REFERENCES:

1. [Fast Track Objective Arithmetic](https://amzn.to/2ZPul7k) by[Rajesh Verma/ Arihant Publications; Fourth edition](https://amzn.to/2ZPul7k) [(2018).](https://amzn.to/2ZPul7k)
2. [Quantitative Aptitude for All Competitive Examinations](https://amzn.to/2LjDsI4) by [AbhijitGuha/ McGraw Hill](https://amzn.to/2LjDsI4) [Education; Sixth edition (25 November 2016).](https://amzn.to/2LjDsI4)

## MA201BS:

**DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS**

#### (Common for ECE, IT, CSE, CSM, CSD, CSC, ME)

**B.Tech. I Year II Sem. L T P C**

**3 1 0 4**

**Course Objectives:** To learn

* Methods of solving the differential equations of first and higher order.
* Concepts & properties of Laplace Transforms
* Solving differential equations using Laplace transform techniques
* Evaluation of multiple integrals and their applications.
* The physical quantities involved in engineering field related to vector valued functions
* The basic properties of vector valued functions and their applications to line, surface and volume integrals

**Course Outcomes:** After learning the contents of this paper the student must be able to

* Solve higher differential equation and apply the concept of differential equation to real world problems
* Use Laplace transform techniques for solving DE’s.
* Evaluate the multiple integrals and apply the concept to find areas, volumes.
* Evaluate the line, surface and volume integrals and converting them from one to another.

## UNIT-I: First Order ODE

Exact, linear and Bernoulli’s equations; Applications : Newton’s law of cooling, Law of natural growth and decay; Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut’s type.

## UNIT-II: Ordinary Differential Equations of Higher Order

Second order linear differential equations with constant coefficients: Non-Homogeneous terms of the type eas, sin ax ,cos ax, polynomials in x, easV(x) and x V(x); method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre’s equation, Cauchy-Euler equation.

## UNIT-III: Multivariable Calculus (Integration)

Evaluation of Double Integrals (Cartesian and polar coordinates); change of order of integration (only Cartesian form); Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals.

Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals), Centre of mass and Gravity (constant and variable densities) by double and triple integrals (applications involving cubes, sphere and rectangular parallel opiped).

## UNIT-IV: Vector Differentiation

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

## UNIT-V: Vector Integration

Line, Surface and Volume Integrals. Theorems of Green, Gauss and Stokes (without proofs) and their applications.

## TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition,2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.

## REFERENCES:

* Paras Ram, Engineering Mathematics, 2nd Edition, CBS Publishes
* S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

## AP202BS: APPLIED PHYSICS

#### (Common for ECE, CSM, ME)

**B.Tech. I Year II Sem. L T P C**

**3 1 0 4**

# Course Objectives:

* The course primarily aims at understanding the behavior of matter in the condensed state and tries to explore the causes with reference to micro level mechanism of the solid matter.
* The objective of the first chapter is to study the micro level behavior of the quantum particles of the matter and their nature as wave and particle.
* The second chapter aims to assess the draw backs of the free electron theory leading to the introduction of the Band Theory of Solids.
* In the third chapter task to discuss dielectric and magnetic properties of the materials.
* In the fourth chapter, it is expected to understand the basic principles behind the coherent artificial light source (LASER) with reference to their construction, mechanism, operation and classification etc. In second part of this chapter aimed at to study an advanced communication system presently ruling the world throughout i.e. Fiber Optic communication system.
* In the fifth chapter plan to discuss on fabrication of nano particles and their characterization techniques.

**Course Outcomes**: After learning the contents of this paper the student must be able to

* Predict the behavior of particle and wave and solve their wave functions.
* Distinguish the different types of Semiconductor devices.
* Recall and choose different materials based on their properties.
* Examine normal light and laser light and its application in communication.
* Categorize Nano materials by fabrication methods.

# UNIT-I:

1. **Principles of quantum mechanics:** Introduction to quantum physics, Waves and particles, Matter waves, de-Broglie Hypothesis, Characteristics of matter waves, Davisson and Germer’s experiment, Heisenberg’s uncertainty principle, Physical significance of the wave function, Schrodinger’s time - independent wave equation, Particle in one dimensional potential Box.
2. **Electron theory of Metals:** Draw backs of classical free electron theory, Electron in a periodic potential, Kronig-Penny model (Qualitative Treatment), Origin of energy band formation in solids, Classification of materials, Effective mass of an electron.

# UNIT-II:

1. **Semiconductor Physics:** Introduction to semi-conductors, Fermi level, Calculation of carrier concentration in intrinsic and extrinsic (p-type & n-type) semiconductors, Direct and indirect band gap semiconductors, Hall effect and applications.
2. **Physics of Semiconductor Devices:** Formation of PN junction, I-V characteristics of PN junction diode, Construction, working and applications: LED, Photo diodes and Solar cells.

# UNIT-III:

1. **Dielectric Properties:** Electric dipole, Dipole moment, Dielectric constant, Electronic, ionic and orientation polarizations and calculation of polarizabilities: electronic and ionic, Internal fields in solids, Clausius - Mossotti equation, concept of Piezo-electricity, Pyro- electricity and Ferro - electricity.
2. **Magnetic Properties:** Origin of magnetic moment, Bohr magneton, Classification of magnetic materials: dia, para, ferro, anti ferro and ferri magnetic materials on the basis of magnetic moment, Domain theory of ferro magnetism on the basis of hysteresis curve.

# UNIT-IV:

1. **Lasers:** Characteristics of lasers, Absorption, Spontaneous and stimulated emission of radiation, Meta stable state, Population inversion, Lasing action, Einstein’s coefficients and relation between them, Ruby laser, Helium-neon laser, Diode laser and applications of lasers.
2. **Fiber Optics:** Principle and construction (structure) of an optical fiber, Acceptance angle, Numerical aperture, Types o optical fibers: step index and graded index fibres, Losses in optical fibers: absorption, scattering and bending and applications of optical fibres in communication.

# UNIT-V:

**1. Nanotechnology:** Origin of nanotechnology, Nano scale, Surface to volume ratio, Quantum confinement, random molecular motion, dominance of electromagnetic forces, Bottom-up fabrication: Sol-Gel method, Top-down fabrication: Chemical vapour Deposition, Physical vapour deposition, Characterization techniques (XRD, SEM & TEM) and applications of nanotechnology.

# TEXT BOOKS:

1. Principles of Physics by Halliday, Resnick, Walker, Wiley India Pvt Ltd, 9th Edition.
2. Introduction to Solid State Physics by Charles Kittel, Wiley India Pvt Ltd, 7th Edition
3. Engineering Physics by R.K.GAUR & S.L.GUPTA, DhanpatRai Publications.
4. Solid State Physics by A J Dekker, MACMILLAN INDIA LTD.

# REFERENCE BOOKS:

1. Modern Engineering Physics by Dr.K.Vijaya Kumar, Dr. S. Chandralingam, S.CHAND & COMPANY LTD
2. Applied Physics by P.K.Mittal, I K International Publishers
3. Applied Physics by P.K. Palanisamy :Scitech publishers
4. Introduction to Nanotechnology by Charles P.Poole, Jr.Frank J ownes, John Wiley & sons
5. Applied Physics for Engineers by P. Madusudana Rao, Academic Publishing Company Engineering Physics by Sanjay D Jain, Girish G Sahasrbudha: University Press

# CS203ES: DATA STRUCTURES

#### (Common for ECE, IT, CSE, CSM, CSD, CSC, ME)

**B.Tech I Year II Sem. L T P C**

**3 0 0 3**

**Prerequisites:** A course on “Programming for Problem Solving”.

# Course Objectives:

* Exploring basic data structures such as stacks and queues.
* Introduces a variety of data structures such as hash tables, search trees, tries, heaps, graphs.
* Introduces sorting and pattern matching algorithms

# Course Outcomes:

* Ability to select the data structures that efficiently model the information in a problem.
* Ability to assess efficiency trade-offs among different data structure implementations or combinations.
* Implement and know the application of algorithms for sorting and pattern matching.
* Design programs using a variety of data structures, including hash tables, binary and general tree structures, search trees, tries, heaps, graphs, and AVL-trees.

# UNIT - I

**Introduction to Data Structures**, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks- Operations, array and linked representations of stacks, stack applications, Queues- operations, array and linked representations.

# UNIT - II

**Dictionaries**: linear list representation, skip list representation, operations - insertion, deletion and searching.

**Hash Table Representation:** hash functions, collision resolution-separate chaining, open addressing-linear probing, quadratic probing, double hashing, rehashing, extendible hashing.

# UNIT - III

**Search Trees:** Binary Search Trees, Definition, Implementation, Operations- Searching, Insertion and Deletion, B–Tree, Operations- Searching, Insertion and Deletion, B+ Tree, Operations- Searching, Insertion and Deletion, AVL Trees, Definition, Height of an AVL Tree, Operations – Insertion, Deletion and Searching, Red

–Black, Splay Trees.

# UNIT - IV

**Graphs:** Graph Implementation Methods. Graph Traversal Methods.

**Sorting:** Heap Sort, External Sorting- Model for external sorting, Merge Sort.

# UNIT - V

**Pattern Matching and Tries:** Pattern matching algorithms-Brute force, the Boyer – Moore algorithm, the Knuth-Morris-Pratt algorithm, Standard Tries, Compressed Tries, Suffix tries.

# TEXTBOOKS:

1. Fundamentals of Data Structures in C,2ndEdition,E.Horowitz,S.Sahniand Susan Anderson Freed, *Universities Press*.
2. DataStructuresusingC– A.S.Tanenbaum,Y.Langsam,andM.J.Augenstein,*PHI/Pearson Education*.

# REFERENCE BOOKS:

**1.** Data Structures: A Pseudocode Approach with C, 2ndEdition, R. F. Gilberg and B.A.

# ME208ES: ENGINEERING MECHANICS

**B.Tech I year II Sem. L T P C**

## 3 1 0 4

**Course Objectives**: The objectives of this course are to

1. Explain the resolution of a system of forces, compute their resultant and solve problems using equations of equilibrium
2. Perform analysis of bodies lying on rough surfaces.
3. Locate the centroid of a body and compute the area moment of inertia and mass moment of inertia of standard and composite sections
4. Explain kinetics and kinematics of particles, projectiles, curvilinear motion, centroidal motion and plane motion of rigid bodies.
5. Explain the concepts of work-energy method and its applications totranslation, rotation and plane motion and the concept of vibrations

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

1. Determine resultant of forces acting on a body and analyse equilibrium of a body subjected to a system off orces.
2. Solve problem of bodies subjected to friction.
3. Find the location of centroid and calculate moment of inertia of a given section.
4. Understand the kinetics and kinematics of a body undergoing rectilinear, curvilinear, rotatory motion and rigid body motion .
5. Solve problems using work energy equations for translation, fixed axis rotation and plane motion and solve problems of vibration

# UNIT-I:

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

# UNIT-II:

Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack; Centroid and Centre of Gravity -Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications. – Theorem of Pappus

# UNIT-III:

Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem

Mass Moment of Inertia : Moment of Inertia of Masses - Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of composite bodies.

# UNIT-IV:

Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton’s 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.

Impulse-momentum (linear, angular); Impact (Direct and oblique).

# UNIT-V:

Kinetics of rigid bodies -basic terms, general principles in dynamics; types of motion, instantaneous centre of rotation in plane motion and simple problems; D’Alembert’s principle and its applications in plane motion and connected bodies; work energy principle and its application in plane motion of connected bodies; kinetics of rigid body rotation.

# TEXT BOOKS:

1. Shames and Rao (2006) , Engineering Mechanics, Pearson Educatio
2. Reddy Vijay Kumar K. and J. Suresh Kumar (2010), Singer’s Engineering Mechanics – Statics & Dynamics

# REFERENCE BOOKS:

1. Timoshenko S.P and Young D.H., “Engineering Mechanics”, McGraw Hill International Edition,1983.
2. Andrew Pytel, Jaan Kiusalaas, “Engineering Mechanics”, Cengage Learning,2014.
3. Beer F.P & Johnston E.R Jr. Vector, “Mechanics for Engineers”, TMH,2004.
4. Hibbeler R.C & Ashok Gupta, “Engineering Mechanics”, Pearson Education,2010.

# ME205ES: ENGINEERING WORKSHOP & IT WORKSHOP

**(Common for ECE, CSM, ME)**

**B.Tech. I Year II Sem. LT P C**

**0 0 3 1.5**

**Pre-requisites**: Practical skill

# Course Objectives:

* To Study of different hand operated power tools, uses and their demonstration
* To gain a good basic working knowledge required for the production of various engineering products.
* To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field.
* To develop a right attitude, team working, precision and safety at workplace.
* It explains the construction, function, use and application of different working tools, equipment and machines.
* To study commonly used carpentry joints.
* To have practical exposure to various welding and joining processes.
* Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

# Course Outcomes:

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

* Apply safety norms while handling the workshop equipment
* Prepare required models using various engineering trades
* Make use of various power tools

**LIST OF EXPERIMENTS**

1. **House Wiring**

## Part-A: Engineering Workshop

Power point, light fitting and switches.

## Carpentry

Study of tools and joints; Practice in planing, chiseling, marking and sawing; Joints: Cross joint, T joint, Dove tail joint.

## Fitting

Study of tools, practice in filing, cutting, drilling and tapping; Male and female joints, stepped joints**.**

## Tin Smithy

Preparation of Open scoop, Cylinder, square/rectangular tray

## Black Smithy

S-Hook, Square /Hexagonal headed bolt.

## Foundry

Preparation of green sand mold using single piece / split pattern

## Demonstration of Power Tools

Drilling machine, power hacksaw, grinding machine and wood cutting machine.

**Part-B: IT Workshop**

# Course Objectives:

The IT Workshop for engineers is a training lab course spread over 54 hours. The modules include training on PC Hardware, Internet & World Wide Web and Productivity tools including Word, Excel and Power Point.

**PC Hardware** introduces the students to a personal computer and its basic peripherals, the process of assembling a personal computer, installation of system software like MS Windows, Linux and the required device drivers. In addition hardware and software level troubleshooting process, tips and tricks would be covered. **The students should work on working PC to disassemble and assemble to working condition and install Windows and Linux on the same PC. Students are suggested to work similar tasks in the Laptop scenario wherever possible.**

**Internet & World Wide Web** module introduces the different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet. Usage of web browsers, email, newsgroups and discussion forums would be covered. In addition, awareness of cyber hygiene, i.e., protecting the personal computer from getting infected with the viruses, worms and other cyber attacks would be introduced.

**Productivity tools** module would enable the students in crafting professional word documents, excel spread sheets and power point presentations using the Microsoft suite of office tools and

LaTeX. (Recommended to use Microsoft office 2007 in place of MS Office 2003)

# Course Outcomes:

* Apply knowledge for computer assembling and software installation.
* Ability how to solve the trouble shooting problems.
* Apply the tools for preparation of PPT, Documentation and budget sheet etc.
* Install and make use of operating systems and MS office tools

1. **WINDOWS OPERATING SYSTEM & DRIVERSINSTALLATION**

Windows 7/8/10. LAN, graphics, audio, video and command prompt, commands.

## NETWORK CONNECTIONS &TROUBLESHOOTING

IP configurations, connecting devices in LAN through bridge, hub, switch; Wi-Fi, Li-Fi and Bluetooth settings; Crimping: Crossover, strait over. Hardware and software trouble shooting.

## Cyber Hygiene

Introduction to Virus, worms, threats. Threats on Internet, Configure the Systems to be Internet safety, Install antivirus, personal firewall, block pop-ups, block active x downloads

## MSWord

Prepare the project document and resume.

## MS Excel

Spread sheet basics, modifying worksheets, formatting cells, formulas and functions, sorting and filtering, charts.

## MS PowerPoint

Power point screen, working with slides, add content, work with text, working with tables, graphics, slide animation, reordering slides, adding sound to a presentation.

## PC Hardware

Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

# TEXT BOOKS:

* + 1. Workshop Practice /B. L. Juneja /Cengage
    2. Workshop Manual / K. Venugopal /Anuradha.
    3. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dreamtech

# REFERENCE BOOKS:

* + - 1. Work shop Manual - P. Kannaiah/ K. L. Narayana/S
      2. Introduction to Information Technology, ITL Education Solutions limited,Pearson Education.

**PH206BS: APPLIED PHYSICS LAB**

**(Common for ECE, CSM, ME)**

## B.Tech. I Year II Sem. L T P C

**0 0 3 1.5**

**LIST OF EXPERIMENTS**

|  |  |
| --- | --- |
| **Week** | **Title/Experiment** |
| 1 | Energy gap of P-N junction diode: To determine the energy gap of a semiconductor diode. |
| 2 | Solar Cell: To study the V-I Characteristics of solar cell. |
| 3 | LED & LASER: To study the I-V characteristics of LED and LASER |
| 4 | Stewart – Gee’s experiment: Determination of magnetic field along the axis of a current carrying coil. |
| 5 | Hall effect: To determine Hall co-efficient of a given semiconductor. |
| 6 | Photoelectric effect: To determine work function of a given material. |
| 7 | Diffraction: Determination of wavelength of a given light source. |
| 8 | Optical fibre: To determine the bending losses and Numerical aperture. |
| 9 | LCR Circuit: To determine the Quality factor of LCR Circuit. |
| 10 | R-C Circuit: To determine the time constant of R-C circuit. |
| 11 | Newton's rings experiment: Determination of radius of curvature of a plano convex lens. |
| **Note: Any 8 experiments should be perform** | |
| **Reference:** Applied Physics Lab Manual, CMREC, Hyd. | |

# CS207ES: DATA STRUCTURES LAB

**(Common for ECE, IT, CSE, CSM, CSD, CSC, ME)**

**B.Tech. I Year II Sem L T P C**

**0 0 2 1**

**Prerequisites:** A Course on “Programming for problem solving”.

# Course Objectives:

* It covers various concepts of C programming language
* It introduces searching and sorting algorithms
* It provides an understanding of data structures such as stacks and queues.

# Course Outcomes:

Ability to develop C programs for computing and real-life applications using basic elements like control statements, arrays, functions, pointers and strings, and data structures like stacks, queues and link edlists.

Ability to Implement searching and sorting algorithms

# LIST OF EXPERIMENTS

1. Write a program that uses functions to perform the following operations on singly linked list.:
   1. Creation ii)Insertion iii)Deletion iv)Traversal
2. Write a program that uses functions to perform the following operations on doubly linked list.:
   1. Creation ii)Insertion iii)Deletion iv)Traversal
3. Write a program that uses functions to perform the following operations on circular linked list.:
   1. Creation ii)Insertion iii)Deletion iv)Traversal
4. Write a program that implement stack (its operations)using
   1. Arrays ii)Pointers
5. Write a program that implement Queue (its operations)using
   1. Arrays ii)Pointers
6. Write a program that implements the following sorting methods to sort a given list of integers in ascending order
   1. Bubblesort ii)Selectionsort iii) Insertionsort
7. Write a program that use both recursive and non-recursive functions to perform the following searching operations for a Key value in a given list of integers:
   1. Linear search ii) Binary search
8. Write a program to implement the tree traversal methods.
   1. In Order ii)Post order iii) Preorder
9. Write a Program to perform the following operations on-Tree
   1. Creation ii)Insertion iii)Deletion iv)Traversal
10. Write a Program to perform the following operations on B +Tree
    1. Creation ii)Insertion iii)Deletion iv)Traversal
11. Write a program to implement the graph traversal methods.

# TEXTBOOKS:

1. FundamentalsofDataStructuresinC,2ndEdition,E.Horowitz,S.SahniandSusanAnder son Freed, *Universities Press*.
2. Data StructuresusingC–A.S.Tanenbaum,Y.Langsam, and M.J.Augenstein,

*PHI/Pearson Education*.

# REFERENCE:

**1.** Data Structures: A Pseudocode Approach with C, 2nd Edition, R. F. Gilberg and B. A.

**EN209HS: BUSINESS ENGLISH COMMUNICATION FORENGINEERS**

**(Common for ECE, CSM, ME)**

|  |  |  |  |
| --- | --- | --- | --- |
| **I Year B.Tech II Sem.** | **L** | **T P** | **C** |
| **Introduction:** | 0 | 0 2 | 0 |

The rapid break down of national barriers over the last decade has resulted in English language skills acquiring a great deal of importance in business sector. Ability to communicate at work place is vital, particularly in the present professional and business climate. In a world with ever-growing levels of globalization and interconnectivity, the significance of Business Communication increased rapidly. But lack of exposure towards Business Communication is a serious handicap forms any aspirants. By recognizing this institution has focused to train the Engineering Students for Business Communication and motivating to appear BEC examination which is an internationally recognized qualification forgetting employability. It has been introduced from B.Tech first year onwards that can instruct and prepare the students to get the advantage when enter the job world. In today’s globalization, it is more significant to show employers that you can communicate in English effectively in every-day business circumstances.

**Course Objectives:**

1. It provides language Skills for real life business situations and improves confidence among students.
2. To train the students to qualify the BEC examination
3. Develop study skills and communication skills informal and in formal situations.

**Course Outcomes:** Students should be able to

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

### Syllabus Exercise-I

* Business Communication Skills: Intrapersonal skills and Interpersonal skills.
* Active Listening Skills- Listening Comprehension.
* Reading skills: Skimming and Scanning.
* Verbal Ability: Fundamentals of Grammar- Sentence Structure - Parts of Speech.
* Online Communication- “The power of word of mouse”: an article on the power of online customer opinions

### Exercise-II

* + Corporate Communication: First impression, Personal Grooming, Corporate &Business etiquettes.
  + Business Relationships: Career advice: letters to an advice column, corporate gift-giving, teamwork, thinking globally- “Global HR Management”: an article.
  + Technical and Business Vocabulary: Idioms, Phrases, Collocations, Abbreviations, and Analogy.
  + Reading Skills: Intensive Reading and Extensive Reading

### Exercise-III

* + Presentation Skills: Group Discussion, Presentations Telephone Handling
  + Reading Comprehension and Techniques: Interpreting bar charts, pie chart, table, and tree diagram.
  + Listening to statistical information: short extracts- “Cafe Coffee Day”: an article on the growth of the Indian Coffee shop;

### Exercise-IV

* + Writing skills: Paragraph writing, Business letters, E-mail, Memo, Report and Essay writing.
  + Recruitment- Preparing for an interview, Staff development: “Advertisements for training courses: variation between a memo and an advert: sport and business” an article.
  + “Picture Description” including Description of Photos/Images/Posters/Advertisement etc.,

### Exercise-V

* + Exercises on Common Errors in Grammar: Tenses, Passive forms, Model verbs, Degrees of comparison, Articles, Reference words, word types and Quantity expressions.
  + Usage of Words: Model verbs of obligation, Contrast words, words to describe causes and effects.
  + Practice of previous BEC Exam: Listening tracks, Reading, Writing and Speaking parts, Communication activities, and Exam skills practice.

### References:

1. Business BENCHMARK,2nd Edition, South Asian Edition Student’s Book- CUP
2. Swan, M. (2016). Practical English Usage. Oxford University Press.
3. Kumar, S and Lata, P. (2018). Communication Skills. Oxford University Press.
4. Wood, F.T. (2007). Remedial English Grammar. Macmillan.
5. Hamp-Lyons, L. (2006). Study Writing. Cambridge University Press.

### Website links:

1. [http://www.cambridge.org](http://www.cambridge.org/)
2. [http://www.learnenglish.com](http://www.learnenglish.com/)
3. [http://www.eslgames.com](http://www.eslgames.com/)
4. <https://www.cambridgeenglish.org/supporting-teachers/>
5. [.https://britishcouncil.zoom.us/webinar/register/WN\_Ddm6jFvxTpWAfYwWeZzX\_Q](https://britishcouncil.zoom.us/webinar/register/WN_Ddm6jFvxTpWAfYwWeZzX_Q)
6. [.https://www.cambridge.org/gb/education/elevate-trial/](https://www.cambridge.org/gb/education/elevate-trial/)
7. <https://learnenglishteens.britishcouncil.org/skills/listening>
8. https:/[/www.cambridgeenglish.org/teaching-english/resources-for-teachers/webinars/assessing-writing-](https://www.cambridgeenglish.org/teaching-english/resources-for-teachers/webinars/assessing-writing-introducing-new-teacher-guides/) [introducing-new-teacher-guides/](https://www.cambridgeenglish.org/teaching-english/resources-for-teachers/webinars/assessing-writing-introducing-new-teacher-guides/)

# CMR ENGINEERING COLLEGE

## MECHANICAL ENGINEERING

**B-Tech II Year COURSE STRUCTURE & SYLLABUS**

## Admitted Year 2020-21

**II YEAR I SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | ME301PC | Mechanics of Solids | 3 | 1 | 0 | 4 |
| 2 | ME302PC | Material Science and Metallurgy | 3 | 0 | 0 | 3 |
| 3 | MA303BS | Probability and Statistics & Complex Variables | 3 | 1 | 0 | 4 |
| 4 | ME304PC | Production Technology | 3 | 0 | 0 | 3 |
| 5 | ME305PC | Thermodynamics | 3 | 0 | 0 | 3 |
| 6 | ME306PC | Production Technology Lab | 0 | 0 | 2 | 1 |
| 7 | ME307PC | Computer Aided Machine Drawing Practice | 0 | 0 | 2 | 1 |
| 8 | ME308PC | Material Science & Mechanics of Solids Lab | 0 | 0 | 2 | 1 |
| 9 | \*MC309 | Environmental Science | 2 | 0 | 0 | 0 |
|  | MC310 | Employability Skills-III | 3 | 0 | 0 | 0 |
|  |  | **Total Credits** | **20** | **2** | **6** | **20** |

## YEARII SEMESTER

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | EE401ES | Basic Electrical and Electronics Engineering | 3 | 0 | 0 | 3 |
| 2 | ME402PC | Kinematics of Machinery | 3 | 1 | 0 | 4 |
| 3 | ME403PC | Thermal Engineering-I | 3 | 0 | 0 | 3 |
| 4 | ME404PC | Fluid Mechanics and Hydraulic Machines | 3 | 1 | 0 | 4 |
| 5 | ME405PC | Instrumentation and Control Systems | 3 | 0 | 0 | 3 |
| 6 | EE406ES | Basic Electrical and Electronics Engineering Lab | 0 | 0 | 2 | 1 |
| 7 | ME407PC | Fluid Mechanics and Hydraulic Machines Lab | 0 | 0 | 2 | 1 |
| 8 | ME408PC | Instrumentation and Control Systems Lab. | 0 | 0 | 2 | 1 |
| 9 | \*MC409 | Gender Sensitization Lab | 0 | 0 | 2 | 0 |
|  | MC410 | Employability Skills-IV | 3 | 0 | 0 | 0 |
|  |  | **Total Credits** | **18** | **2** | **8** | **20** |

**\*MC – Satisfactory/Unsatisfactory**

## ME301PC: MECHANICS OF SOLIDS

#### B.Tech. II Year I Sem. L T/P/D C

**3 1 / 0 /0 4**

**Course Objectives:** The objective is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force- deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.

This course will advance the students’ development of the following broad capabilities:

* Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.
* Students will be able to understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.
* Students will understand how to develop shear-moment diagrams of a beam and find the maximum moment/shear and their locations
* Students will understand how to calculate normal and shear stresses

**Course Outcomes:**

* Analyze the behavior of the solid bodies subjected to various types of loading;
* Apply knowledge of materials and structural elements to the analysis of simple structures;
* Undertake problem identification, formulation and solution using a range of analytical methods;
* Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.
* Expectation and capacity to undertake lifelong learning

### UNIT – I

**Simple Stresses & Strains:** Elasticity and plasticity – Types of stresses & strains–Hooke’s law– stress– strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson’s ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section

– composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

### UNIT – II

**Shear Force and Bending Moment:** Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

### UNIT – III

**Flexural Stresses:** Theory of simple bending – Assumptions – Derivation of bending equation: M/I

= f/y = E/R Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

**Shear Stresses:** Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

### UNIT – IV

**Principal Stresses and Strains:** Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses. Two perpendicular normal stresses accompanied by a state of simple shear – Mohr’s circle of stresses Principal stresses and strains – Analytical and graphical solutions.

**Theories of Failure**: Introduction – Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory).

### UNIT - V

**Torsion of Circular Shafts:** Theory of pure torsion – Derivation of Torsion equations: T/J = q/r = Nθ/L Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.

**Thin Cylinders:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells.

### TEXT BOOKS:

1. Strength of materials – R.S. Kurmi and Gupta.
2. Solid Mechanics, by Popov
3. Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
4. Strength of Materials – W.A. Nash, TMH

### REFERENCES:

1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani.
3. Mechanics of Structures Vol –I by H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.
4. Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
5. Strength of Materials by S. S. Rattan, Tata McGraw Hill Education Pvt. Ltd.
6. Fundamentals of Solid Mechanics by M. L. Gambhir, PHI Learning Pvt. Ltd
7. Strength of Materials by R.K Rajput, S. Chand & Company Ltd.

### ME302PC: MATERIAL SCIENCE AND METALLURGY

**B.Tech. II Year I Sem. L T / P / D C**

### 3 0 / 0 / 0 3

**UNIT – I**

Crystal Structure: Unit cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

### UNIT – II

Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and microstrctural aspects of ledeburite, austenite, ferrite and cementite, cast iron

### UNIT –III

Heat treatment of Steel: Annealing, Normalising, Hardening, Tempering and Spheroidising, Isothermal transformation diagrams for Fe-C alloys and microstructures development.

### UNIT – IV

Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

### UNIT – V

Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys (Brass, bronze and cupro- nickel)- Aluminium and Al-Cu – Mg alloys- Titanium alloys

### TEXT BOOKS:

1.V. Raghavan, “Material Science and Engineering’, Prentice Hall of India Private Limited, 1999.

2.W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.

### REFERENCE BOOKS:

1.Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.

2.U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.

## MA303BS: PROBABILITY AND STATISTICS & COMPLEX VARIABLES

### B.Tech. II Year I Sem. L T/P/D C

**3 1/0/ 0 4**

**Pre-requisites:** Mathematical Knowledge at pre-university level

**Course Objectives:** To learn

* The ideas of probability and random variables and various discrete and continuous probability distributions and their properties.
* The basic ideas of statistics including measures of central tendency, correlation and regression.
* The statistical methods of studying data samples.
* Differentiation and integration of complex valued functions.
* Evaluation of integrals using Cauchy’s integral formula and Cauchy’s residue theorem.
* Expansion of complex functions using Taylor’s and Laurent’s series.

**Course outcomes:** After learning the contents of this paper the student must be able to

* Formulate and solve problems involving random variables and apply statistical methods
* for analysing experimental data.
* Analyse the complex function with reference to their analyticity, integration using Cauchy’s integral and residue theorems.
* Taylor’s and Laurent’s series expansions of complex function.

### UNIT - I: Basic Probability

Probability spaces, conditional probability, independent events, and Bayes’ theorem.

Random variables: Discrete and continuous random variables, Expectation of Random Variables, Moments, Variance of random variables

### UNIT - II: Probability distributions

Binomial, Poisson, evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution Continuous random variables and their properties, distribution functions and density functions, Normal and exponential, evaluation of statistical parameters for these distributions

### UNIT - III: Testing of Hypothesis

Test of significance: Basic of testing of Hypothesis. Null and alternate Hypothesis, types of errors, level of significance, critical region. Large sample test for single proportion, difference of proportions, single mean, difference of means; small sample tests: Test for single mean, difference of means and test for ratio of variances

### UNIT - IV: Complex Variables (Differentiation)

Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations (without proof), finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

### UNIT - V: Complex Variables (Integration)

Line integral, Cauchy’s theorem, Cauchy’s Integral formula, Zeros of analytic functions, Singularities, Taylor’s series, Laurent’s series; Residues, Cauchy Residue theorem, Conformal mappings, Mobius transformations and their properties.

### TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, 9th Edition, Pearson Publications.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw

Hill, 2004.

### REFERENCES:

1. Fundamentals of Mathematical Statistics, Khanna Publications, S. C. Gupta and V. K. Kapoor.
2. Miller and Freund’s, Probability and Statistics for Engineers, 8th Edition, Pearson Educations
3. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.

### ME304PC: PRODUCTION TECHNOLOGY

**B.Tech. II Year I Sem L T/P/D C**

### 3 0/0/0 3

**Pre-requisites:** None

### 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 suitability 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.
* To teach the thermal and mechanical aspects, such as force, stress, strain and temperature of the most common processes.
* To provide a technical understanding of common processes to aid in appropriate process selection for the material and required tolerances
* To provide a technical understanding of common processes to aid in appropriate material selection for a predetermined process.

**Course Outcomes**: Student will be able to :

* Understand the idea for selecting materials for patterns.
* Know Types and allowances of patterns used in casting and analyze the components of moulds.
* Design core, core print and gating system in metal casting processes
* Understand the arc, gas, solid state and resistance welding processes.
* Develop process-maps for metal forming processes using plasticity principles.
* Identify the effect of process variables to manufacture defect free products.

### UNIT – I

**Casting:** Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances; design of patterns, moulds and cores; Properties of moulding sands. Methods of Melting - Crucible melting and cupola operation – Defects in castings; Principles of Gating– Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design, solidification and cooling. Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Solidification of casting – Solidification of pure metal, Directional Solidification.

### UNIT – II

**Welding:** Classification – Types of welds and welded joints; Welding Positions - Gas welding - Types, oxy-fuel gas cutting – standard time and cost calculations. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

### UNIT – III

Inert Gas Welding \_ TIG Welding, MIG welding, Friction welding, Friction Stir Welding, induction welding, explosive welding, Laser Welding; Soldering, Brazing and adhesive bonding; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

### UNIT – IV

Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth. Sheet metal Operations: Stamping, Blanking and piercing, Coining, Strip layout, Hot and cold spinning – Bending and deep drawing. Rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements. Drawing and its types – wire drawing and Tube drawing –. Types of presses and press tools. Forces and power requirement in the above operations.

### UNIT – V

**Extrusion of Metals:** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion- Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion, Hydrostatic extrusion. Forces in extrusion

**Forging Processes:** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**High Energy Rate Forming Processes:** Limitations, Principles of Explosive Forming, Electro- hydraulic Forming, Electro-magnetic forming and rubber pad Forming.

### Principles of Powder Metallurgy.

**TEXT BOOKS:**

1. Manufacturing Technology / P.N. Rao Vol.1 & 2 / McGraw Hill
2. Manufacturing Engineering & Technology / Serope Kalpakjian / Steven R. Schmid / Pearson

### REFERENCE BOOKS:

1. Metal Casting / T.V Ramana Rao / New Age
2. Production Technology / G. Thirupathi Reddy / Scitech
3. Manufacturing Processes/ J.P. Kaushish / PHI Publications

## ME305PC: THERMODYNAMICS

### B.Tech. II Year I Sem. L T/P/D C

**3 0/0/0 3**

**Pre-requisite**: Engineering Chemistry and Physics

**Course Objective**: To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications

**Course Outcomes**: At the end of the course, the student should be able to Understand and differentiate between different thermodynamic systems and processes. Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes and to perform thermodynamic analysis. Understand and analyze the Thermodynamic cycles and evaluate performance parameters.

### Tables/Codes: Steam Tables and Mollier Chart, Refrigeration Tables UNIT – I

**Introduction: Basic Concepts:** System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics

– Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

### UNIT - II

PMM I - Joule’s Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation.

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump , Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot’s principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics

### UNIT – III

Pure Substances, p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations

– Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes

### UNIT - IV

Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton’s Law of partial pressure, Avogadro’s Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour, Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Carrier’s Equation – Psychrometric chart.

### UNIT - V

**Power Cycles:** Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.

### Refrigeration Cycles:

Brayton and Rankine cycles – Performance Evaluation – combined cycles, Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

### TEXT BOOKS:

1. Engineering Thermodynamics / PK Nag / McGraw Hill
2. Thermodynamics for Engineers / Kenneth A. Kroos ; Merle C. Potter/ Cengage

### REFERENCE BOOKS:

1. Engineering Thermodynamics / Chattopadhyay/ Oxford
2. Engineering Thermodynamics / Rogers / Pearson

### ME306PC: PRODUCTION TECHNOLOGY LAB

**B.Tech. II Year I Sem. L T/P/D C**

### 0 0/2/0 1

**Pre-requisites:** Production Technology

### Course Outcomes:

* Understanding the properties of moulding sands and pattern making.
* Fabricate joints using gas welding and arc welding.
* Evaluate the quality of welded joints.
* Basic idea of press working tools and performs moulding studies on plastics.

### Minimum of 12 Exercises need to be performed

1. **Metal Casting Lab:**
   1. Pattern Design and making - for one casting drawing.
   2. Sand properties testing - Exercise -for strengths, and permeability – 1
   3. Moulding Melting and Casting - 1 Exercise

### Welding Lab:

* 1. ARC Welding Lap & Butt Joint - 2 Exercises
  2. Spot Welding - 1 Exercise
  3. TIG Welding - 1 Exercise
  4. Plasma welding and Brazing 2 Exercises (Water Plasma Device)

### Mechanical Press Working:

* 1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
  2. Hydraulic Press: Deep drawing and extrusion operation.
  3. Bending and other operations

### Processing Of Plastics

* 1. Injection Moulding
  2. Blow Moulding

### REFERENCE BOOK:

1. Dictionary of Mechanical Engineering – G.H.F. Nayler, Jaico Publishing House.

## ME307PC: COMPUTER AIDED MACHINE DRAWING PRACTICE

### B.Tech. II Year I Sem. L T/P/D C

**0 0/2/0 1**

**Pre-requisites:** Engineering graphics

**Course objectives:** To familiarize with the standard conventions for different materials and machine parts in working drawings. To make part drawings including sectional views for various machine elements. To prepare assembly drawings given the details of part drawings.

### Course Outcomes:

* Preparation of engineering and working drawings with dimensions and bill of material during design and development. Developing assembly drawings using part drawings of machine components.
* Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.
* Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.
* Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features.
* Title boxes, their size, location and details - common abbreviations and their liberal usage
* Types of Drawings – working drawings for machine parts using CAD.

Introduction to CAD, Conventional representation of materials, common machine elements and parts such as screws, nuts, bolts, keys, gears, webs, ribs.Types of sections – selection of section planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.

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

Title boxes, their size, location and details - common abbreviations and their liberal usage Types of Drawings – working drawings for machine parts using CAD.

### Drawing of Machine Elements and simple parts using CAD

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

1. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
2. Keys, cottered joints and knuckle joint.
3. Rivetted joints for plates
4. Shaft coupling, spigot and socket pipe joint.
5. Journal, pivot and collar and foot step bearings.

### Assembly Drawings:

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

1. Steam engine parts – stuffing boxes, cross heads, Eccentrics.
2. Machine tool parts: Tail stock, Tool Post, Machine Vices.
3. Other machine parts - Screws jacks, Petrol engine connecting rod, Plummer block, Fuel Injector
4. Valves - Steam stop valve, spring loaded safety valve, feed check valve and air cock.

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

### TEXT BOOKS:

1. Machine Drawing / N.D. Bhatt / Charotar
2. Machine Drawing with Auto CAD / Goutham Pohit, Goutam Ghosh / Pearson

### REFERENCE BOOKS:

1. Machine Drawing by / Bhattacharyya / Oxford
2. Machine Drawing / Ajeet Singh / McGraw Hill
3. Machine Drawing / N.D.Bhatt / Charotar

### ME308PC: MATERIAL SCIENCE & MECHANICS OF SOLIDS LAB

**B.Tech. II Year I Sem. L T/P/D C**

### 0 0/2/0 1

**MATERIAL SCIENCE:**

**Course Objective:** The purpose of this course is to make the students learn the concepts of Metallurgy and Material Science role in all manufacturing processes which convert raw materials into useful products adapted to human needs.

**Course Outcomes:** The Primary focus of the Metallurgy and Material science program is to provide undergraduates with a fundamental knowledge based associated materials properties, and their selection and application. Upon graduation, students would have acquired and developed the necessary background and skills for successful careers in the materials-related industries. Furthermore, after completing the program, the student should be well prepared for management positions in industry or continued education toward a graduate degree.

### List of Experiments:

1. Preparation and study of crystal models for simple cubic, body centred cubic, face centred Cubic and hexagonal close packed structures.
2. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
3. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
4. Study of the Microstructures of Cast Irons.
5. Study of the Microstructures of Non-Ferrous alloys.
6. Hardenability of steels by Jominy End Quench Test.

### MECHANICS OF SOLIDS:

**Course Objectives:** The objective is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force- deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.

The students will advance the students’ development of the following broad capabilities:

* + Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.
  + Students will be able to understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.
  + Students will understand how to develop shear-moment diagrams of a beam and find the maximum moment/shear and their locations
  + Students will understand how to calculate normal and shear stresses on any cross-section of a beam. Different cross-sections (including I-beam) will be discussed and applied Continuous Assessment Test 10 marks Mid Semester Test 15 marks End

### Course Outcomes

* + - Analyze the behavior of the solid bodies subjected to various types of loading.
    - Apply knowledge of materials and structural elements to the analysis of simple structures.
    - Undertake problem identification, formulation and solution using a range of analytical methods
    - Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.
    - Expectation and capacity to undertake lifelong learning.

### List of Experiments:

* 1. Direct tension test
  2. Bending test on Simple supported beam
  3. Bending test on Cantilever beam
  4. Torsion test
  5. Brinell hardness test/ Rockwell hardness test
  6. Test on springs
  7. Izod Impact test/ Charpy Impact test

### \*MC309: ENVIRONMENTAL SCIENCE

**(Common for CSM, ME, ECE)**

### B.Tech. I Year I Sem. L /T /P /D C

**2 /0 /0 /0 0**

### Course Objectives:

* Understanding the importance of ecological balance for sustainable development.
* Understanding the impacts of developmental activities and mitigation measures.
* Understanding the environmental policies and regulations

### Course Outcomes:

Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

### UNIT-I

**Ecosystems:** Definition, Scope, and Importance of ecosystem. Classification, structure, and function of an ecosystem, Food chains, food webs, and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnifications, ecosystem value, services and carrying capacity, Field visits.

### UNIT-II

**Natural Resources: Classification of Resources:** Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

### UNIT-III

**Biodiversity And Biotic Resources:** Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values.

India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

### UNIT-IV

**Environmental Pollution and Control Technologies: Environmental Pollution:** Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary. Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Issues and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

### UNIT-V

**Environmental Policy, Legislation & EIA:** Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio- economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development Goals, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

### TEXT BOOKS:

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

### REFERENCE BOOKS:

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS.Publications.

### MC310: EMPLOYABILITY SKILLS III

**B.Tech. II Year I Sem. L T/P/D C**

### 3 0/0/0 0

**Unit: 1**

### Module 1 - Introduction to Python and Computer Programming

* + Python - a tool, not a reptile
  + There is more than one Python
  + Let's start our Python adventure

### Module 2 - Data Types, Variables, Basic Input-Output Operations, Basic Operators

* + Your first program
  + Python literals
  + Operators - data manipulation tools
  + Variables - data-shaped boxes
  + How to talk to computer?

### Unit: 2

**Module 3 - Boolean Values, Conditional Execution, Loops, Lists and List Processing, Logical and Bitwise Operations**

* + Making decisions in Python
  + Python's loops
  + Logic and bit operations in Python
  + Lists - collections of data
  + Sorting simple lists - the bubble sort algorithm
  + Lists - some more details
  + Lists in advanced applications

### Module 4 - Functions, Tuples, Dictionaries, and Data Processing

* + Writing functions in Python
  + How functions communicate with their environment?
  + Returning a result from a function
  + Scopes in Python
  + Let's make some fun... sorry, functions
  + Tuples and dictionaries

### Module 5 - Modules, Packages, String and List Methods, and Exceptions

* + Using modules
  + Some useful modules
  + What is package?
  + Errors - the programmer's daily bread
  + The anatomy of exception
  + Some of the most useful exceptions
  + Characters and strings vs. computers
  + Python's nature of strings
  + String methods
  + Strings in action
  + Four simple programs

#### Unit: 3

**Module 6 - The Object-Oriented Approach: Classes, Methods, Objects, and the Standard Objective Features; Exception Handling, and Working with Files**

* + Basic concepts of object programming
  + A short journey from procedural to object approach
  + Properties
  + Methods
  + Inheritance - one of object programming foundations
  + Exceptions once again
  + Generators and closures
  + Processing files
  + Working with real files

#### Unit: 4

**Module: 7 Data Structures**

* + List Data Structures
  + Stacks
  + Queues
  + Searching & Sorting
  + Trees
  + Graphs

#### Unit: 5

**Module: 8 Databases Management, Mysql & MongoDB**

* + Creating Database
  + Insertion
  + Deletion
  + Updating
  + Selection

### EE401ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

**B.Tech. II Year II Sem L T/P/D C**

### 3 0/0/0 3

**Course Objectives:**

* To introduce the concepts of electrical circuits and its components
* To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
* To study and understand the different types of DC/AC machines and Transformers.
* To import the knowledge of various electrical installations.
* To introduce the concept of power, power factor and its improvement.
* To introduce the concepts of diodes & transistors, and
* To impart the knowledge of various configurations, characteristics and applications.

### Course Outcomes:

* To analyze and solve electrical circuits using network laws and theorems.
* To understand and analyze basic Electric and Magnetic circuits
* To study the working principles of Electrical Machines
* To introduce components of Low Voltage Electrical Installations
* To identify and characterize diodes and various types of transistors.

### UNIT - I:

**D.C. CIRCUITS**

Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation.

### A.C. 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 , Three-phase balanced circuits, voltage and current relations in star and delta connections.

### UNIT - II:

**ELECTRICAL INSTALLATIONS**

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

### UNIT - III:

**ELECTRICAL MACHINES**

Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three-phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three-phase Induction motor, Torques equations and Speed control of Three-phase induction motor. Construction and working principle of synchronous generators.

### UNIT - IV:

**P-N JUNCTION AND ZENER DIODE:** Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications.

**RECTIFIERS AND FILTERS:** P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

### UNIT - V:

**BIPOLAR JUNCTION TRANSISTOR (BJT):** Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations.

**FIELD EFFECT TRANSISTOR (FET):** Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

### TEXT BOOKS:

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

### REFERENCES:

1. Electronic Devices and Circuits – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman’s Electronic Devices and Circuits – J. Millman and C. C. Halkias, SatyabrataJit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
7. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
8. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
9. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

### ME402PC: KINEMATICS OF MACHINERY

**B.Tech. II Year II Sem. L T/P/D C**

### 3 1/0/0 4

**Prerequisites:** Basic principles of Mechanics

**Course Objectives:** The objective is to study the relative motion, velocity, and accelerations of the various elements in a mechanism. In mechanical Engineering we come across number of mechanisms such as four bar/slider crank/double slider crank/straight line motion mechanism etc. Mechanism deals with only relative motions. Once we make a study considering for us also there it is called kinetics. The first course deals with mechanisms, their inversions straight line motion mechanisms steering mechanisms etc. Also study of cams/gears & gear trains & belts are also introduced.

**Course Outcomes:** The main purpose is to give an idea about the relative motions obtained in all the above type of components used in mechanical Engineering.

### UNIT – I

**Mechanisms:** Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematics pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully and incompletely constrained.

**Mechanism and Machines** – Mobility of Mechanisms: Grubler’s criterion, classification of machines – kinematics chain – inversions of mechanism – inversions of quadric cycle chain, single and double slider crank chains, Mechanical Advantage.

### UNIT – II

**Kinematics:** Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method.

**Plane motion of body:** Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method.

Kliens construction - Coriolis acceleration - determination of Coriolis component of acceleration **Analysis of Mechanisms:** Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.

### UNIT – III

**Straight-line motion mechanisms:** Exact and approximate copied and generated types – Peaucellier

-Hart - Scott Russel – Grasshopper – Watt -Tchebicheff’s and Robert Mechanism - Pantographs **Steering gears:** Conditions for correct steering – Davis Steering gear, Ackerman’s steering gear. **Hooke’s Joint:** Single and double Hooke’s joint –velocity ratio – application – problems.

### UNIT – IV

**Cams:** Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

**Analysis of motion of followers:** Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

### UNIT – V

**Higher pair:** Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding

Forms of teeth, cycloidal and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements– Introduction to Helical – Bevel and worm gearing

**Gear Trains:** Introduction – Types – Simple – compound and reverted gear trains – Epicyclic gear train. Methods of finding train value or velocity ratio of Epicyclic gear trains. Selection of gear box - Differential gear for an automobile.

### TEXT BOOKS:

1. Theory of Machines and Mechanisms/JOSEPH E. SHIGLEY/ Oxford
2. Theory of Machines / S. S. Rattan / McGraw Hill Publishers.

### REFERENCE BOOKS:

1. Theory of Machines / Sadhu Singh / Pearson.
2. Theory of Machines / Thomas Bevan/CBS.

### ME403PC: THERMAL ENGINEERING – I

**B.Tech. II Year II Sem. L T/P/D C**

### 3 0/0/0 3

**Pre-requisite**: Thermodynamics

**Course Objective**: To apply the laws of Thermodynamics to analyze air standard cycles and to understand and evaluate the perform analysis of the major components and systems of IC engines, refrigeration cycles and their applications.

**Course Outcomes**: At the end of the course, the student should be able to evaluate the performance of IC engines and compressors under the given operating conditions. Apply the laws of Thermodynamics to evaluate the performance of Refrigeration and air-conditioning cycles. Understand the functionality of the major components of the IC Engines and effects of operating conditions on their performance

### UNIT – I

**I.C. Engines:** Classification - Working principles of Four & Two stroke engine, SI & CI engines, Valve and Port Timing Diagrams, Air – Standard, air-fuel and actual cycles - Engine systems – Carburetor and Fuel Injection Systems for SI engines, Fuel injection systems for CI engines, Ignition, Cooling and Lubrication system, Fuel properties and Combustion Stoichiometry.

### UNIT – II

Normal Combustion and abnormal combustion in SI engines – Importance of flame speed and effect of engine variables – Abnormal combustion, pre-ignition and knocking in SI Engines – Fuel requirements and fuel rating, anti-knock additives – combustion chamber – requirements, types of SI engines. Four stages of combustion in CI engines – Delay period and its importance – Effect of engine variables-Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence in Diesel engine – open and divided combustion chambers and fuel injection– Diesel fuel requirements and fuel rating

### UNIT - III

**Testing and Performance:** Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart

Classification of compressors – Fans, blowers and compressors – positive displacement and dynamic types – reciprocating and rotary types.

**Reciprocating Compressors:** Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance volume, staged compression, under cooling, saving of work, minimum work condition for staged compression

### UNIT – IV

**Rotary Compressor (Positive displacement type):** Roots Blower, vane sealed compressor, Lysholm compressor – mechanical details and principle of working – efficiency considerations.

**Dynamic Compressors:** Centrifugal compressors: Mechanical details and principle of operation – velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.

**Axial Flow Compressors:** Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency- pressure rise calculations-Polytropic efficiency.

### UNIT – V

**Gas Turbines:** Simple Gas Turbine Plant – Ideal Cycle – Closed Cycle and Open Cycle for Gast Turbines, Constant Pressure Cycle, Constant Volume Cycle, Efficiency – Work Ratio and Optimum Pressure Ration for Simple Gas Turbine Cycle. Parameters of Performance, Actual Cycle, Regeneration , Intercooling and Reheating – Closed and Semi-Closed Cycle

### TEXT BOOKS:

1. I.C. Engines / V. Ganesan / McGraw Hill
2. Thermal Engineering / Mahesh M Rathore / McGraw Hill

### REFERENCE BOOKS:

1. Applied Thermodynamics for Engineering Technologists / Eastop / Pearson
2. Fundamentals of Classical Thermodynamics / Vanwylen G.J., Sonntag R.E. / Wiley Eastern
3. Internal Combustion Engines Fundamentals – John B. Heywood – McGraw Hill Ed.

### ME404PC: FLUID MECHANICS AND HYDRAULIC MACHINES

**B.Tech. II Year II Sem. L T/P/D C**

### 3 1/0/0 4

**Course Objectives:** The objectives of the course are to enable the student;

* To understand the basic principles of fluid mechanics
* To identify various types of flows
* To understand boundary layer concepts and flow through pipes
* To evaluate the performance of hydraulic turbines
* To understand the functioning and characteristic curves of pumps

### Course Outcomes:

* Able to explain the effect of fluid properties on a flow system.
* Able to identify type of fluid flow patterns and describe continuity equation.
* To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design.
* To select and analyze an appropriate turbine with reference to given situation in power plants.
* To estimate performance parameters of a given Centrifugal and Reciprocating pump.
* Able to demonstrate boundary layer concepts.

### UNIT - I

**Fluid statics**: Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension - vapour pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

### UNIT - II

**Fluid kinematics**: Stream line, path line and streak lines and stream tube, classification of flows-steady & unsteady, uniform & non-uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.

**Fluid dynamics**: Surface and body forces –Euler’s and Bernoulli’s equations for flow along a stream line, momentum equation and its application on force on pipe bend.

### UNIT - III

**Boundary Layer Concepts:** Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

**Closed conduit flow:** Reynold’s experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line. Measurement of flow: Pitot tube, venturi meter, and orifice meter, Flow nozzle

### UNIT - IV

**Basics of turbo machinery:** Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

**Hydraulic Turbines:** Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design draft tube theory- functions and efficiency.

**Performance of hydraulic turbines**: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

### UNIT - V

**Centrifugal pumps**: Classification, working, work done – barometric head- losses and efficiencies specific speed- performance characteristic curves, NPSH.

**Reciprocating pumps:** Working, Discharge, slip, indicator diagrams.

### TEXT BOOKS:

1. Hydraulics, Fluid mechanics and Hydraulic Machinery - MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput.

### REFERENCES:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria& Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga& Sharma, Khanna Publishers.

### ME405PC: INSTRUMENTATION AND CONTROL SYSTEMS

**B.Tech. II Year II Sem. L T/P/D C**

### 3 0/0/0 3

**Prerequisite:** Mathematics-I, Thermodynamics, Basic of Electrical and Electronics Engineering.

### Course Objectives:

* + Understanding the basic characteristic of a typical instrument.
  + Identifying errors and their types that would occur in an instrument.
  + Identifying properties used for evaluating the thermal systems.
  + The concept of transducer and Various types and their characters.

### Course Outcome:

* + To identify various elements and their purpose in typical instruments, to identify various errors that would occur in instruments.
  + Analysis of errors so as to determine correction factors for each instrument.
  + To understand static and dynamic characteristics of instrument and should be able to determine loading response time.
  + For given range of displacement should be able to specify transducer, it accurate and loading time of that transducer.

### UNIT – I

Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and Dynamic performance characteristics– sources of errors, Classification and elimination of errors. Measurement of Displacement: Theory and construction of various transducers to measure displacement – Using Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers; Calibration procedures.

### UNIT – II

Measurement of Temperature: Various Principles of measurement-Classification: Expansion Type: Bimetallic Strip- Liquid in glass Thermometer; Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation Pyrometry: Optical Pyrometer; Changes in Chemical Phase: Fusible Indicators and Liquid crystals. Measurement of Pressure: Different principles used- Classification: Manometers, Dead weight pressure gauge Tester (Piston gauge), Bourdon pressure gauges, Bulk modulus pressure gauges, Bellows, Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges, ionization pressure gauges, McLeod pressure gauge.

### UNIT – III

Measurement of Level: Direct methods – Indirect methods – Capacitive, Radioactive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators –Bubbler level indicators.

Flow measurement: Rotameter, magnetic, Ultrasonic, Turbine flow-meter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).

Measurement of Speed: Mechanical Tachometers, Electrical tachometers, Non- contact type Stroboscope; Measurement of Acceleration and Vibration: Different simple instruments – Principles

of Seismic instruments – Vibrometer and accelerometer using this principle- Piezo electric accelerometer.

### UNIT – IV

Stress-Strain measurements: Various types of stress and strain measurements –Selection and installation of metallic strain gauges; electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending, compressive and tensile strains – Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes.

Measurement of Humidity: Moisture content of gases, Sling Psychrometer, Absorption Psychrometer, Dew point meter. Measurement of Force, Torque and Power- Elastic force meters, load cells, Torsion meters, Dynamometers.

### UNIT – V

Elements of Control Systems: Introduction, Importance – Classification – Open and closed systems- Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems- Transfer functions- First and Second order mechanical systems

### TEXT BOOKS:

1. Principles of Industrial Instrumentation & Control Systems, - Alavala, - Cengage Learning
2. Basic Principles – Measurements (Instrumentation) & Control Systems – S. Bhaskar – Anuradha Publications.

### REFERENCE BOOKS:

1. Measurement Systems: Applications & design, E. O. Doebelin, TMH
2. Instrumentation, Measurement & Analysis, B.C. Nakra& K.K. Choudhary, TMH
3. Experimental Methods for Engineers / Holman
4. Mechanical and Industrial Measurements / R. K. Jain/ Khanna Publishers.
5. Mechanical Measurements / Sirohi and Radhakrishna / New Age International.

### EE406ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

**B.Tech. II Year II Sem. L T/P/D C**

### 0 0/2/0 1

**Pre-requisites:** Basic Electrical and Electronics Engineering

### Course Objectives:

* To introduce the concepts of electrical circuits and its components
* To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
* To study and understand the different types of DC/AC machines and Transformers.
* To import the knowledge of various electrical installations.
* To introduce the concept of power, power factor and its improvement.
* To introduce the concepts of diodes & transistors, and
* To impart the knowledge of various configurations, characteristics and applications.

### Course Outcomes:

* To analyze and solve electrical circuits using network laws and theorems.
* To understand and analyze basic Electric and Magnetic circuits
* To study the working principles of Electrical Machines
* To introduce components of Low Voltage Electrical Installations
* To identify and characterize diodes and various types of transistors.

### List of experiments/demonstrations:

**PART A: ELECTRICAL**

1. Verification of KVL and KCL
2. (i) Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer

(ii) Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta- star, Star-Star) in a Three Phase Transformer

1. Measurement of Active and Reactive Power in a balanced Three-phase circuit
2. Performance Characteristics of a Separately Excited DC Shunt Motor
3. Performance Characteristics of a Three-phase Induction Motor
4. No-Load Characteristics of a Three-phase Alternator

### PART B: ELECTRONICS

1. Study and operation of
2. Multi-meters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO.
3. PN Junction diode characteristics
4. Zener diode characteristics and Zener as voltage Regulator
5. Input & Output characteristics of Transistor in CB / CE configuration
6. Full Wave Rectifier with & without filters
7. Input and Output characteristics of FET in CS configuration

### TEXT BOOKS:

* 1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
  2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

### REFERENCES:

1. Electronic Devices and Circuits – R. L. Boylestead and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman’s Electronic Devices and Circuits – J. Millman and C. C. Halkias, SatyabrataJit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company,

6th edition.

1. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
2. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
3. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
4. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
5. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
6. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.

### B.Tech. II Year II Sem. L T/P/D C

**0 0/2/0 1**

### Course Objectives:

* To understand the basic principles of fluid mechanics.
* To identify various types of flows.
* To understand boundary layer concepts and flow through pipes.
* To evaluate the performance of hydraulic turbines.
* To understand the functioning and characteristic curves of pumps.

### Course Outcomes:

* Able to explain the effect of fluid properties on a flow system.
* Able to identify type of fluid flow patterns and describe continuity equation.
* To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
* To select and analyze an appropriate turbine with reference to given situation in power plants.
* To estimate performance parameters of a given Centrifugal and Reciprocating pump.
* Able to demonstrate boundary layer concepts

### List of Experiments:

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Verification of Bernoulli’s Theorems.

### B.Tech. II Year II Sem. L T/P/D C

**0 0/2/0 1**

**Pre-requisites**: Basic principles of Instrumentation and control systems

**Course Outcomes:** At the end of the course, the student will be able to Characterize and calibrate measuring devices. Identify and analyze errors in measurement. Analyze measured data using regression analysis. Calibration of Pressure Gauges, temperature, LVDT, capacitive transducer, rotameter.

### LIST OF EXPERIMENTS:

1. Calibration of Pressure Gauges.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for temperature measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotameter for flow measurement.
10. Study and use of a Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. Study and calibration of McLeod gauge for low pressure.
12. Measurement and control of Pressure of a process using SCADA system.
13. Measurement and control of level in a tank using capacitive transducer with SCADA.
14. Measurement and control of temperature of a process using resistance temperature detector with SCADA.

(An Activity – based Course)

### B.Tech. II Year II Sem. L T/P/D C

**0 0/2 /0 0**

### COURSE DESCRIPTION

This course offers an introduction to Gender Studies, an interdisciplinary field that asks critical questions about the meanings of sex and gender in society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary. It draws on multiple disciplines – such as literature, history, economics, psychology, sociology, philosophy, political science, anthropology and media studies – to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with race, class, caste, nationality and other social identities. This course also seeks to build an understanding and initiate and strengthen programmes combating gender-based violence and discrimination. The course also features several exercises and reflective activities designed to examine the concepts of gender, gender-based violence, sexuality, and rights. It will further explore the impact of gender-based violence on education, health and development.

### Objectives of the Course:

* To develop students’ sensibility with regard to issues of gender in contemporary India.
* To provide a critical perspective on the socialization of men and women.
* To introduce students to information about some key biological aspects of genders.
* To expose the students to debates on the politics and economics of work.
* To help students reflect critically on gender violence.
* To expose students to more egalitarian interactions between men and women.

### Learning Outcomes:

* Students will have developed a better understanding of important issues related to gender in contemporary India.
* Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
* Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
* Students will acquire insight into the gendered division of labour and its relation to politics and economics.
* Men and women students and professionals will be better equipped to work and live together as equals.
* Students will develop a sense of appreciation of women in all walks of life.
* Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

### UNIT - I: UNDERSTANDING GENDER

Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men Preparing for Womanhood. Growing up Male. First lessons in Caste.

### UNIT – II: GENDER ROLES AND RELATIONS

Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles- Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its Consequences- Declining Sex Ratio. Demographic Consequences-Gender Spectrum: Beyond the Binary

### UNIT – III: GENDER AND LABOUR

Division and Valuation of Labour-Housework: The Invisible Labor- “My Mother doesn’t Work.” “Share the Load.”-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work. - Gender Development Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender and Mainstreaming

### UNIT – IV: GENDER - BASED VIOLENCE

The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights Perspective-Sexual Harassment: Say No! -Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: “*Chupulu”.*

Domestic Violence: Speaking OutIs Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-“I Fought for my Life….”

### UNIT – V: GENDER AND CULTURE

Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular Literature- Gender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature - Just Relationships: Being Together as Equals/Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Rosa Parks- The Brave Heart.

**Note:**Since it is Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

*Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments. Apart from the above prescribed book, Teachers can make use of any authentic materials related to the topics given in the syllabus on “Gender”.*

ESSENTIAL READING: The Textbook, “*Towards a World of Equals: A Bilingual Textbook on Gender” written* by A.Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, VasudhaNagaraj, Asma Rasheed, GoguShyamala, DeepaSreenivas and Susie Tharupublished by Telugu Akademi, Telangana Government in 2015.

### ASSESSMENT AND GRADING:

* + Discussion & Classroom Participation: 20%
  + Project/Assignment: 30%
  + End Term Exam: 50%

### MC410: EMPLOYABILITY SKILLS IV

**B.Tech. II Year II Sem. L T/P/D C**

### 3 0/0 /0 0

**Java Course Syllabus Unit: 1**

**Introduction**

* Why Java
* Paradigms
* Diff B/W Java & Other (C,C++)
* Java History
* Java Features
* Java programming format
* Java Statements
* Java Data Types

### Unit: 2

**OOPS (Object Oriented Programming & Systems)**

* Introduction
* Object
* Constructors
* This Key Word
* Inheritance
* Super Key Word
* Polymorphism (Over Loading & Over Riding)
* Abstraction
* Interface
* Encapsulation
* Introduction to all predefined packages
* User Defined Packages
* Access Specifiers

### Unit: 3

**STRING Manipulation**

* String
* String Buffer

**Array**

* What is Array
* Single Dimensional Array
* Multi Dimensional Array
* Sorting of Arrays

#### Unit: 4 Packages

**Exception Handling**

* Introduction
* Pre Defined Exceptions
* Try-Catch-Finally
* Throws, throw
* User Defined Exception examples

**I/O Streams**

* Introduction
* Byte-oriented streams
* Character – oriented streams
* File

#### Unit: 5 Multithreading

* Introduction
* Thread Creations
* Thread Life Cycle
* Life Cycle Methods
* Synchronization
* Wait() notify() notify all() methods

**Wrapper Classes**

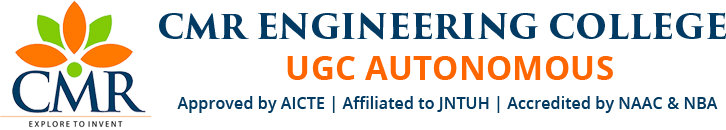
* Introduction
* Byte, Short, Integer, Long, Float, Double, Character
* Boolean classes

**Inner Classes**

* Introduction
* Member Inner Class
* Static Inner Class
* Local Inner Class
* Anonymous Inner Class

**Collection Frame Work**

* Introduction
* Util Package interfaces, List, Set, Map
* List Interface 7 Its Classes
* Set Interface & Its Classes
* Map Interface & Is Classes



## B.Tech in MECHANICAL ENGINEERING

### COURSE STRUCTURE & SYLLABUS (R20)

**Applicable From 2020-21 Admitted Batch**

## YEAR I SEMESTER

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | SM501MS | Business Economics and Financial Analysis | 3 | 0 | 0 | 3 |
| 2 | ME502PC | Dynamics of Machinery | 3 | 1 | 0 | 4 |
| 3 | ME503PC | Design of Machine Elements-I | 3 | 0 | 0 | 3 |
| 4 | ME504PC | Metrology & Machine Tools | 3 | 0 | 0 | 3 |
| 5 | ME505PC | Thermal Engineering-II | 3 | 0 | 0 | 3 |
| 6 | ME506PC | Operations Research | 3 | 0 | 0 | 3 |
| 7 | ME507PC | Kinematics & Dynamics Lab | 0 | 0 | 2 | 1 |
| 8 | ME508PC | Metrology & Machine Tools Lab | 0 | 0 | 2 | 1 |
| 9 | ME509PC | Thermal Engineering Lab | 0 | 0 | 2 | 1 |
| 10 | \*MC509 | Constitution of India | 3 | 0 | 0 | 0 |
|  | \*MC511 | Cyber Security | 3 | 0 | 0 | 0 |
|  |  | **Total Credits** | **24** | **1** | **6** | **22** |

1. **YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | ME601PC | Design of Machine Elements-II | 3 | 0 | 0 | 3 |
| 2 | ME602PC | Heat Transfer | 3 | 1 | 0 | 4 |
| 3 | ME603PC | Finite Element Methods | 3 | 0 | 0 | 3 |
|  | ME604PC | CAD & CAM | 3 | 0 | 0 | 3 |
| 4 |  | **Professional Elective-I** | 3 | 0 | 0 | 3 |
| 5 |  | **Open Elective-I / MOOCs** | 3 | 0 | 0 | 3 |
| 6 | ME605PC | Heat Transfer Lab | 0 | 0 | 2 | 1 |
| 7 | ME606PC | CAD & CAM LAB | 0 | 0 | 2 | 1 |
| 8 | EN606HS | Advanced Communication Skills Lab | 0 | 0 | 2 | 1 |
| 9 | \*MC609 | Intellectual Property Rights | 3 | 0 | 0 | 0 |
|  | \*MC611 | Artificial Intelligence | 3 | 0 | 0 | 0 |
|  |  | **Total Credits** | **24** | **1** | **6** | **22** |

#### SM501MS: BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

**B.Tech. III Year I Sem. L T P C**

#### 3 0 0 3

**Course Objective:** To learn the basic Business types, impact of the Economy on Business and Firms specifically. To analyze the Business from the Financial Perspective.

**Course Outcome:** The students will understand the various Forms of Business and the impact of economic variables on the Business. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt. The Students can study the firm’s financial position by analysing the Financial Statements of a Company.

#### UNIT – I: Introduction to Business and Economics

**Business**: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance.

**Economics:** Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply in Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

#### UNIT – II: Demand and Supply Analysis

**Elasticity of Demand:** Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting.

**Supply Analysis:** Determinants of Supply, Supply Function & Law of Supply.

#### UNIT – III: Production, Cost, Market Structures & Pricing

**Production Analysis:** Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.

**Cost analysis**: Types of Costs, Short run and Long run Cost Functions.

**Market Structures**: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, Monopolistic Competition.

**Pricing:** Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, Cost Volume Profit Analysis.

**UNIT – IV: Financial Accounting:** Accounting concepts and Conventions, Accounting Equation, Double Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, Preparation of Final Accounts.

**UNIT – V: Financial Analysis through Ratios:** Concept of Ratio Analysis, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios (simple problems).

Introduction to Fund Flow and Cash Flow Analysis (simple problems).

#### TEXT/ REFERENCE BOOKS:

1. D. D. Chaturvedi, S. L. Gupta, Business Economics - Theory and Applications, InternationalBook House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata McGraw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata McGrawHill Education Pvt. Ltd. 201

#### ME502PC: DYNAMICS OF MACHINERY

**B.Tech. III Year I Sem. L T P C**

#### 3 1 0 3

**Pre-requisite:** Kinematics of Machinery

**Course Objectives:** The objective is to introduce some of the components mainly used in IC Enginesand make analysis of various forces involved. Subjects deals with topics like inertia forces in slider crankmechanism; IC Engine components & the analysis like governors is introduced. It also deals with balancing of rotating & reciprocating parts. Studies are made about balancing of multi cylinder engines, Radial engines etc. study of primary & secondary forces are considered while balancing. Finally they are introduced to the topic of vibrations. The study deals with linear, longitudinal, & torsional vibrations. The idea is to introduce the concept of natural frequency and the importance of resonance and criticalspeeds.

**Course Outcome:** the study of KOM & DOM are necessary to have an idea while designing the various machine members like shafts, bearings, gears, belts & chains and various I.C. Engine Components & Machine tool parts.

#### UNIT – I

**Precession:** Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships.

**Static and Dynamic Force Analysis:** Static force analysis of planar mechanisms – Analytical Method – Dynamic Force Analysis – D’Alembert’s principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism.

#### UNIT – II

**Turning Moment Diagram and Flywheels:** Engine Force Analysis – Piston Effort, Crank Effort, etc., Inertia Force in Reciprocating Engine – Graphical Method - Turning moment diagram – fluctuation of energy – flywheels and their design - Inertia of connecting rod- inertia force in reciprocating engines – crank effort and torque diagrams.-.

#### UNIT – III

**Friction:** pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricatedsurfaces – boundary friction – film lubrication. Clutches – Types – Single plate, multi- plate and cone clutches. **Brakes and Dynamometers:** Types of brakes: Simple block brake, band and block brake- internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

#### UNIT – IV

**Governors:** Types of governors - Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting **–** stability – effortand power of the governors.

**Balancing:** Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples. Examination of “V” and multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort.

#### UNIT – V

**Vibrations:** Free Vibration of mass attached to vertical spring – Transverse loads – vibrations of beamswith concentrated and distributed loads. Dunkerly’s method – Raleigh’s method. Whirling of

shafts – critical speed – torsional vibrations – one, two and three rotor systems.

#### TEXT BOOKS:

1. Theory of Machines /S.S.Rattan / Mc Graw Hill.
2. Theory of Machines /Sadhu Singh/ Pearson

#### REFERENCE BOOKS:

1. Theory of Machines and Mechanisms/Joseph E. Shigley / Oxford
2. Theory of Machines / Rao,J.S & R.V. Duggipati/ New Ag

#### ME503PC: DESIGN OF MACHINE MEMBERS - I

**B.Tech. III Year I Sem. L T** P C

#### 3 0 0 3

**Note:** Design Data books are not permitted in the Examinations. The design must not only satisfystrength criteria but also rigidity criteria.

**Pre-requisites:** Engineering mechanics, mechanics of solids, manufacturing processes, metallurgyand material science.

#### Course Objectives:

* To understand the general design procedures and principles in the design of machine elements.
* To study different materials of construction and their properties and factors determining theselection of material for various applications.
* To determine stresses under different loading conditions.
* To learn the design procedure of different fasteners, joints, shafts and couplings.

#### Course Outcomes:

* The student acquires the knowledge about the principles of design, material selection, component behavior subjected to loads, and criteria of failure.
* Understands the concepts of principal stresses, stress concentration in machine members andfatigue loading.
* Design on the basis of strength and rigidity and analyze the stresses and strains induced in amachine element.

#### UNIT – I

**Introduction:** General considerations in the design of Engineering Materials and their properties – selection –Manufacturing consideration in design. Tolerances and fits –BIS codes of steels.

**Design for Static Strength:** Simple stresses – Combined stresses – Torsional and Bending stresses

– Impact stresses – Stress strain relation – Various theories of failure – Factor of safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations.

#### UNIT – II

**Design for Fatigue Strength:** Stress concentration–Theoretical stress Concentration factor–Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Gerber’s curve– Goodman’s line– Soderberg’s line.

#### UNIT – III

**Riveted, Welded and Bolted Joints:** Riveted joints- methods of failure of riveted joints-strength equations-efficiency of riveted joints-eccentrically loaded riveted joints.

Welded joints-Design of fillet welds-axial loads-circular fillet welds under bending, torsion. Welded joints under eccentric loading.

Bolted joints – Design of bolts with pre-stresses – Design of joints under eccentric loading – locking devices – bolts of uniform strength.

#### UNIT – IV

**Keys, Cotters and Knuckle Joints:** Design of keys-stresses in keys-cottered joints-spigot and socket, sleeve and cotter, Gib and cotter joints-Knuckle joints.

#### UNIT – V

**Shafts:** Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined

bending and axial loads – Shaft sizes – BIS code. - Gaskets and seals (stationary & rotary)

**Shaft Couplings:** Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Flange coupling

(Modified).

#### TEXT BOOKS:

1. Design of Machine Elements / V. Bhandari / Mc Graw Hill
2. Machine Design / Jindal / Pearson

#### REFERENCE BOOKS:

1. Design of Machine Elements / V. M. Faires / Macmillan
2. Design of Machine Elements-I / Kannaiah, M.H / New Age

#### ME504PC: METROLOGY AND MACHINE TOOLS

**B.Tech. III Year I Sem. L T P C**

#### 3 0 0 3

**Pre-requisites: None**

**Course Objectives:** The course content enables students to:

* Acquire the knowledge of Engineering metrology and its practice which is having increasingimportance in industry.
* Specifically make the student to improve applications aspect in the measurements and control of process of manufacture
* Impart the fundamental aspects of the metal cutting principles and their application in studyingthe behavior of various machining processes.
* Train in knowing the fundamental parts of various machine tools and their kinematic schemes.
* Discuss various principles of jigs and fixtures which will be used to hold and guide the workpieces and cutting tools in various machine tools

**Course Outcome:** At the end of the course, the student would be able to

* Identify techniques to minimize the errors in measurement.
* Identify methods and devices for measurement of length, angle, gear & thread parameters,surface roughness and geometric features of parts.
* Understand working of lathe, shaper, planer, drilling, milling and grinding machines.
* Comprehend speed and feed mechanisms of machine tools.
* Estimate machining times for machining operations on machine tools

#### UNIT – I

Metal cutting: Introduction, elements of cutting process – Geometry of single point tools. Chip formationand types of chips. Engine lathe – Principle of working, types of lathe, specifications. Taper turning,– Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts.

#### UNIT – II

Drilling and Boring Machines – Principles of working, specifications, types, operations performed;twist drill. Types of Boring machines and applications. Shaping, slotting and planing machines – Principles of working – machining time calculations.

#### UNIT – III

Milling machines – Principles of working – Types of milling machines – Geometry of milling cutters methods of indexing. Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel. Lapping, honing and broaching machines, comparison and Constructional features, machining time calculations

#### UNIT – IV

Limits, fits and tolerances- Types of Fits - Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly.

**Limit Gauges:** Taylor’s principle, Design of GO and NO-GO gauges, Measurement of angles using Bevel protractor and Sine bar. Measurement of flatness using straight edges, surface plates, optical flatand auto collimator.

#### UNIT – V

Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf. Screw thread measurement, Gear measurement; Machine Tool Alignment Tests on lathe, milling and drilling machines. Coordinate Measuring Machines: Typesand Applications of CMM.

#### TEXT BOOKS:

1. Machine Tool Practices/ Kibbe, Johne. Neely, T. White, Rolando O. Meyer/ Pearson
2. Engineering Metrology/ R.K. Jain/ Khanna Publishers.

#### REFERENCE BOOKS:

1. Principles of Machine Tools, Bhattacharyya A and Sen.G.C / New Central Book Agency.
2. Fundamentals of Dimensional Metrology / Connie Dotson / Thomson
3. Fundamentals of Metal Machining and Machine Tools / Geoffrey Boothroyd / McGraw Hill
4. Principles of Engineering Metrology/ Rega Rajendra/ Jaico Publishers.
5. Metrology and Measurement/ Bewoor & Kulkarni/ Tata Mc Graw Hill

#### ME505PC: THERMAL ENGINEERING - II

**B.Tech. III Year I Sem. L T P C**

#### 3 0 0 3

**Note:** Steam Table book Permitted.

**Pre-requisite**: Thermodynamics

**Course Objective**: To apply the laws of Thermodynamics to analyze steam and gas turbine cycles and to perform analysis of the major components of steam and gas turbine plants and their applications.

**Course Outcomes**: At the end of the course, the student should be able to

* Develop state – space diagrams based on the schematic diagrams of process flow of steam and gas turbine plants
* Apply the laws of Thermodynamics to analyze thermodynamic cycles
* Differentiate between vapour power cycles and gas power cycles
* Infer from property charts and tables and to apply the data for the evaluation of performance parameters of the steam and gas turbine plants
* Understand the functionality of major components of steam and gas turbine plants and to do the analysis of these components

#### UNIT – I

**Steam Power Plant:** Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating.

**Boilers** – Classification – Working principles with sketches including H.P.Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification – Height of chimney for given draught and discharge- Condition for maximum discharge- Efficiency of chimney.

#### UNIT – II

**Steam Nozzles:** Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge- Critical pressure ratio- Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson line.

#### UNIT – III

**Steam Turbines:** Classification – Impulse turbine; Mechanical details – Velocity diagram – Effect of friction – Power developed, Axial thrust, Blade or diagram efficiency– Condition for maximum efficiency. De-Laval Turbine - its features- Methods to reduce rotor speed-Velocity compounding and Pressure compounding- Velocity and Pressure variation along the flow – Combined velocity diagram for a velocity compounded impulse turbine.

**Reaction Turbine:** Mechanical details – Principle of operation, Thermodynamic analysis of a stage, Degree of reaction –Velocity diagram – Parson’s reaction turbine – Condition for maximum efficiency.

#### UNIT - IV

**Steam Condensers**: Requirements of steam condensing plant – Classification of condensers – Working principle of different types – Vacuum efficiency and Condenser efficiency – Air leakage, sources and its affects, Air pump- Cooling water requirement.

**Gas Turbines:** Simple gas turbine plant – Ideal cycle, essential components – Parameters of

performance – Actual cycle – Regeneration, Inter cooling and Reheating –Closed and Semi-closed cycles – Merits and Demerits- Combustion chambers and turbines of Gas Turbine Plant- BriefConcepts.

#### UNIT – V

**Jet Propulsion:** Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation – Methods.

**Rockets:** Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency – Specific Impulse – Solid and Liquid propellant Rocket Engines.

#### TEXT BOOKS:

1. Thermal Engineering / Mahesh M Rathore/ Mc Graw Hill
2. Gas Turbines – V. Ganesan /Mc Graw Hill

#### REFERENCE BOOKS:

* 1. Gas Turbine Theory/ Saravanamuttoo, Cohen, Rogers/ Pearson
  2. Fundamentals of Engineering Thermodynamics / Rathakrishnan/ PHI
  3. Thermal Engineering/ Rajput/ Lakshmi Publications

#### ME506PC: KINEMATICS AND DYNAMICS LAB

**B.Tech. III Year I Sem. L T P C**

#### 0 0 2 1

**Pre-requisites:**

Prerequisites for the graduate-level course are Kinematics, Dynamics, differential equations, motion simulation, displacement, velocity, acceleration, force, torque, power, Newton’s motion laws, vibration, Gyroscopic Effect, Cams, Bearings.

**Course Objectives:** The objective of the lab is to understand the kinematics and dynamics of mechanical elements such as linkages, gears, cams and learn to design such elements to accomplish desired motions or tasks.

**Course Outcomes:** Upon successful completion of this lab, students should be able to:

* Understand types of motion
* Analyze forces and torques of components in linkages
* Understand static and dynamic balance
* Understand forward and inverse kinematics of open-loop mechanisms

**Experiments:** (A Minimum of 10 experiments are to be conducted)

1. To determine the state of balance of machines for primary and secondary forces
2. To determine the frequency of torsional vibration of a given rod
3. Determine the effect of varying mass on the centre of sleeve in porter and proell governor
4. Find the motion of the follower if the given profile of the cam
5. The balance masses statically and dynamically for single rotating mass systems
6. Determine the critical speed of a given shaft for different n-conditions
7. For a simple pendulum determine time period and its natural frequency
8. For a compound pendulum determine time period and its natural frequency
9. Determine the effect of gyroscope for different motions
10. Determine time period, amplitude and frequency of undamped free longitudinal vibration ofsingle degree spring mass systems.
11. Determine the pressure distribution of lubricating oil at various load and speed of a Journalbearing.
12. Determine time period, amplitude and frequency of damped free longitudinal vibration of singledegree spring mass systems

#### ME507PC: METROLOGY AND MACHINE TOOLS LAB

**B.Tech. III Year I Sem. L T P C**

#### 0 0 2 1

**Course Objectives:**

1. To import practical exposure to the metrology equipment & Machine Tools
2. To conduct experiments and understand the working of the same.

**Prerequisites:** Theoretical exposure to Metrology and machine tools.

#### List of Experiments:

1. Step turning on lathe machine
2. Taper turning on lathe machine
3. Thread cutting and knurling on lathe machine (2 exercises)
4. Making of keyways on slotting machine
5. Machining of holes using Drilling and boring machines.
6. Gear cutting on the Milling machine
7. Grinding of Tool angles using Cylindrical / Surface Grinding
8. Measurement of lengths, heights, diameters by vernier calipers, micrometers.
9. Measurement of Diameter of bores by internal micrometers and dial bore indicators.
10. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height ofthe spur gear.
11. Angle and taper measurements by bevel protractor and sine bars.
12. Thread measurement by 2-wire and 3-wire methods.
13. Surface roughness measurement by Tally Surf.
14. Use of spirit level and optical flats in finding the flatness of surface plate.

#### ME508PC: THERMAL ENGINEERING LAB

**B.Tech. III Year I Sem. L T P C**

#### 0 0 2 1

**Pre-Requisite:** Thermodynamics & Thermal Engineering - I

**Objective:** To understand the working principles of IC Engines, Compressors.

#### List of Experiments

1. I.C. Engines Valve / Port Timing Diagrams
2. I.C. Engines Performance Test for 4 Stroke SI engines
3. I.C. Engines Performance Test for 2 Stroke SI engines
4. I.C. Engines Morse, Retardation, Motoring Tests
5. I.C. Engine Heat Balance – CI/SI Engines
6. I.C. Engines Economical speed Test on a SI engine
7. I.C. Engines effect of A/F Ratio in a SI engine
8. Performance Test on Variable Compression Ratio Engine
9. IC engine Performance Test on a 4S CI Engine at constant speed
10. Volumetric efficiency of Air – Compressor Unit
11. Dis-assembly / Assembly of Engines
12. Study of Boilers

**Note:** Perform any 10 out of the 12 Exercises.

#### \*MC509 CONSTITUTION OF INDIA

**B.Tech. III Year I Sem. L T P C**

#### 3 0 0 0

The Constitution of India is the supreme law of India. Parliament of India cannot make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the “basic structure” of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of “Constitutionalism” – a modern and progressive concept historically developed by the thinkers of “liberalism” – an ideology which has been recognized as one of the most popular political ideology andresult of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of “constitutionalism” in many countries. The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America.

The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India’s legacy of “diversity”. It has been said that Indian constitution reflects ideals of its freedom movement; however, few critics have argued that it does not truly incorporate our own ancient legal heritage and cultural values. No law can be “static” and thereforethe Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court ofIndia and its historic contributions has been recognized throughout the world and it gradually made it “as one of the strongest court in the world”.

#### Course content

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and theStates
8. Parliamentary Form of Government in India – The constitution powers and status of thePresident of India
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

#### \*MC511 CYBER SECURITY

**B.Tech. III Year I Sem. L T P C**

#### 3 0 0 0

**Prerequisites: NIL**

#### Course objectives:

* To familiarize various types of cyber-attacks and cyber-crimes
* To give an overview of the cyber laws
* To study the defensive techniques against these attacks

**Course Outcomes:** The students will be able to understand cyber-attacks, types of cybercrimes, cyberlaws and also how to protect them self and ultimately the entire Internet community from such attacks.

#### UNIT - I

**Introduction to Cyber Security:** Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

#### UNIT - II

**Cyberspace and the Law & Cyber Forensics:** Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy.

Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

#### UNIT - III

**Cybercrime: Mobile and Wireless Devices:** Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in MobileComputing Era, Laptops.

#### UNIT- IV

**Cyber Security: Organizational Implications:** Introduction, cost of cybercrimes and IPR issues, webthreats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.

**Cybercrime and Cyber terrorism:** Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

#### UNIT - V

**Privacy Issues:** Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

#### Cybercrime: Examples and Mini-Cases

**Examples:** Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of

Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.

**Mini-Cases:** The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

#### TEXT BOOKS:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, ComputerForensics and Legal Perspectives, Wiley
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles,Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

#### REFERENCES:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

#### ME601PC: DESIGN OF MACHINE MEMBERS - II

**B.Tech. III Year II Sem. L T P C**

#### 3 0 0 3

**Note:** Design Data Book is permitted. Design of all components should include design for strength and rigidity apart from engineering performance requirements.

**Pre-requisites**: Study of engineering mechanics, design of machine members-I and theory of machines.

#### Course objectives:

* To gain knowledge about designing the commonly used important machine members such as bearings, engine parts, springs, belts, gears etc.
* To design the components using the data available in design data books.

#### Course Outcomes:

* Knowledge about journal bearing design using different empirical relations.
* Estimation of life of rolling element bearings and their selection for given service conditions.
* Acquaintance with design of the components as per the standard, recommended procedureswhich is essential in design and development of machinery in industry.

#### UNIT – I

**Sliding contact bearings:** Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design.

#### UNIT – II

**Rolling contact bearings:** Ball and roller bearings – Static load – dynamic load – equivalent radial load

– design and selection of ball & roller bearings.

#### UNIT – III

**Engine Parts:** Connecting Rod: Thrust in connecting rod – stress due to whipping action on connectingrod ends –Pistons, Forces acting on piston – Construction, Design and proportions of piston.

#### UNIT – IV

**Mechanical Springs:** Stresses and deflections of helical springs – Extension and compression springs

* Design of springs for fatigue loading – natural frequency of helical springs – Energy storage capacity
* helical torsion springs – Design of co-axial springs, Design of leaf springs.

**Belts & Pulleys**: Transmission of power by Belt and Rope Drives, Transmission efficiencies, Belts –Flat and V types – Ropes - pulleys for belt and rope drives.

#### UNIT – V

**Gears:** Spur gears& Helical gears- Brief introduction involving important concepts – Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

#### TEXT BOOKS:

1. Design of Machine Elements / Spotts/ Pearson
2. Machine Design / Pandya & Shah / Charothar

#### REFERENCE BOOKS:

1. Design of Machine Elements-II / Kannaiah / New Age
2. Design of Machine Elements / Sharma and Purohit/PHI
3. Design Data Book/ P.V. Ramana Murti & M. Vidyasagar/ B.S. Publications
4. Design Data Handbook/ S. Md. Jalaludeen/ Anuradha Publishers

#### ME602PC: HEAT TRANSFER

**B.Tech. III Year II Sem. L T P C**

#### 3 1 0 4

**Note:** Heat Transfer Data Book is permitted.

**Pre-requisite**: Thermodynamics

**Course Objectives**: To provide knowledge about application of conduction, convection and radiationheat transfer concepts to different practical applications

**Course Outcome**: At the end of this course, student will be able to

* Understand the basic modes of heat transfer
* Compute one dimensional steady state heat transfer with and without heat generation
* Understand and analyze heat transfer through extended surfaces
* Understand one dimensional transient conduction heat transfer
* Understand concepts of continuity, momentum and energy equations
* Interpret and analyze forced and free convective heat transfer
* Understand the principles of boiling, condensation and radiation heat transfer
* Design of heat exchangers using LMTD and NTU methods

#### UNIT – I

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

**Conduction Heat Transfer:** Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady,and periodic heat transfer – Initial and boundary conditions

**One Dimensional Steady State Conduction Heat Transfer:** Homogeneous slabs, hollow cylinders, and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radiusof insulation

#### UNIT – II

**One Dimensional Steady State Conduction Heat Transfer:** Variable Thermal conductivity – systems with heat sources or Heat Generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature

**One Dimensional Transient Conduction Heat Transfer:** Systems with negligible internal resistance

* Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinite body.

#### UNIT – III

**Convective Heat Transfer:** Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation

* Buckingham Theorem and method, application for developing semi – empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

**Forced convection: External Flows:** Concepts about hydrodynamic and thermal boundary layer anduse of empirical correlations for convective heat transfer -Flat plates and Cylinders.

#### UNIT – IV

**Internal Flows:** Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.**Free Convection:** Development of Hydrodynamic and thermal boundary layer along a vertical plate - Use of empirical relations for Vertical plates and pipes.

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

#### UNIT - V

**Heat Transfer with Phase Change:**

**Boiling**: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling. **Condensation:** Film wise and drop wise condensation –Nusselt’s Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

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

#### TEXT BOOKS:

1. Heat and Mass Transfer – Dixit /Mc Graw Hill
2. Heat and Mass Transfer / Altamush Siddiqui/ Cengage

#### REFERENCE BOOKS:

1. Essential Heat Transfer - Christopher A Long / Pearson
2. Heat Transfer –Ghoshdastidar / Oxford

#### ME603PC: FINITE ELEMENT METHODS

**B.Tech. III Year II Sem. L T P C**

#### 3 0 0 3

**Pre-requisites**: Mechanics of Solids

**Course Objective**: The aim of the course is to provide the participants an overview on Finite ElementMethod, Material models, and Applications in Civil Engineering. At the end of the course, the participants are expected to have fair understanding of:

* Basics of Finite Element Analysis.
* Available material models for structural materials, soils and interfaces/joints.
* Modeling of engineering systems and Soil–Structure Interaction (SSI).
* Importance of interfaces and joints on the behavior of engineering systems.
* Implementation of material model in finite element method and applications

**Course Outcomes**: At the end of the course, the student will be able to, Apply finite element methodto solve problems in solid mechanics, fluid mechanics and heat transfer. Formulate and solve problems in one dimensional structures including trusses, beams and frames. Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi- symmetric and plate bending problems. ANSYS, ABAQUS, NASTRAN, etc.

#### UNIT – I

Introduction to Finite Element Methods: General Procedure – Engineering Applications – Stress and Equilibrium, Strain – Displacement relations. Stress – strain relations: Finite Elements: 1- Dimensional,2 – Dimensional, 3-Dimensional & Interpolation Elements

**One Dimensional Problems:** 1-D Linear and 1-D Quadratic Elements - Finite element modeling, Coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite elementequations, Treatment of boundary conditions, Quadratic shape functions.

#### UNIT – II

**Analysis of Trusses:** Derivation of Stiffness Matrix for Plane Truss, Displacement of Stress Calculations.

**Analysis of Beams:** Element stiffness matrix for two noded, two degrees of freedom per node beam element, Load Vector, Deflection.

#### UNIT – III

Finite element modeling of two-dimensional stress analysis with constant strain triangles and treatmentof boundary conditions, Estimation of Load Vector, Stresses

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four noded Isoparametric elements and numerical integration.

#### UNIT – IV

**Steady State Heat Transfer Analysis**: one dimensional analysis of Slab, fin and two-dimensional analysis of thin plate.

#### UNIT – V

**Dynamic Analysis:** Formulation of finite element model, element - Mass matrices, evaluation of Eigenvalues and Eigen vectors for a stepped bar, truss and beam.

Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation. techniques such as semi-automatic and fully Automatic use of softwares such as ANSYS, ABAQUS, NASTRAN using Hexahedral and Tetrahedral Elements.

#### TEXT BOOKS:

1. Finite Element Methods: Basic Concepts and applications/Alavala/PHI
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu /Pearson

#### REFERENCE BOOKS:

1. An Introduction to the Finite Element Method / J. N. Reddy/ Mc Graw Hill
2. Finite Element Analysis / SS Bhavikatti / New Age
3. Finite Element Method/ Dixit/Cengage

#### ME604PC: CAD & CAM

**B.Tech. III Year II Sem. L T P C**

#### 3 0 0 3

**Pre-requisites:** To learn the importance and use of computer in design and manufacture

**Course objectives:** To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture. To understand the need for integration of CAD and CAM

**Course Outcomes:** Understand geometric transformation techniques in CAD. Develop mathematical models to represent curves and surfaces. Model engineering components using solid modeling techniques. Develop programs for CNC to manufacture industrial components. To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

#### UNIT – I

Fundamentals of CAD/ CAM, Application of computers for Design and Manufacturing, Benefits of CAD/CAM - Computer peripherals for CAD/ CAM, Design workstation, Graphic terminal, CAD/ CAMsoftware- definition of system software and application software, CAD/ CAM database and structure. **Geometric Modeling:** Wire frame modeling, wire frame entities, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques,definitions of cubic spline, Bezier, and B-spline.

#### UNIT - II

**Surface modeling:** Algebraic and geometric form, Parametric space of surface, Blending functions, parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

**Solid Modelling:** Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

#### UNIT – III

**NC Control Production Systems:** Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

#### UNIT – IV

**Group Technology:** Part families, Parts classification and coding. Production flow analysis, Machinecell design.

**Computer aided process planning:** Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

**Computer aided manufacturing resource planning:** Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

#### UNIT – V

**Flexible manufacturing system**: F.M.S equipment, FMS layouts, Analysis methods for FMS benefitsof FMS.

**Computer aided quality control**: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

**Computer Integrated Manufacturing:** CIM system, Benefits of CIM

#### TEXT BOOKS:

1. CAD/CAM Concepts and Applications / Alavala / PHI
2. CAD/CAM Principles and Applications / P. N. Rao / Mc Graw Hill

#### REFERENCE BOOKS:

1. CAD/CAM/ Groover M.P/ Pearson
2. CAD/CAM/CIM/ Radhakrishnan and Subramanian / New Age

#### ME605PC: HEAT TRANSFER LAB

**B.Tech. III Year II Sem. L T P C**

#### 0 0 2 1

**Pre-requisite**: Thermodynamics

**Course Objectives**: To enable the student to apply conduction, convection and radiation heattransfer concepts to practical applications

**Course Outcome**: At the end of the lab sessions, the student will be able to

* Perform steady state conduction experiments to estimate thermal conductivity of differentmaterials
* Perform transient heat conduction experiment
* Estimate heat transfer coefficients in forced convection, free convection, condensation andcorrelate with theoretical values
* Obtain variation of temperature along the length of the pin fin under forced and freeconvection
* Perform radiation experiments: Determine surface emissivity of a test plate and Stefan-Boltzmann’s constant and compare with theoretical value

#### Minimum twelve experiments from the following:

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Film and Drop wise condensation apparatus

#### ME606PC: CAD & CAM LAB

**B.Tech. III Year II Sem. L T P C**

#### 0 0 2 1

**Pre-requisites:** To give the exposure to usage of software tools for design and manufacturing. To acquire the skills needed to analyze and simulate engineering systems.

**Course Objectives:** To be able to understand and handle design problems in a systematic manner. To be able to apply CAD in real life applications. To be understand the basic principles of different typesof analysis.

**Course Outcomes:** To understand the analysis of various aspects in of manufacturing design

#### Note: conduct any TEN excercises from the list gien below:

1. Drafting: Development of part drawings for various components in the form of orthographic and isometric. Representation of dimensioning and tolerances.
2. Part Modeling: Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features. Study of parent child relation. Feature based and Boolean based modeling and Assembly Modeling. Study of various standard Translators. Design of simple components.
3. Determination of deflection and stresses in 2D and 3D trusses and beams.
4. Determination of deflections, principal and Von-mises stresses in plane stress, plane strain andAxi-symmetric components.
5. Determination of stresses in 3D and shell structures (at least one example in each case)
6. Estimation of natural frequencies and mode shapes, Harmonic response of 2D beam.
7. Study state heat transfer analysis of plane and axi-symmetric components.
8. Development of process sheets for various components based on Tooling and Machines.
9. Development of manufacturing defects and tool management systems.
10. Study of various post processors used in NC Machines.
11. Development of NC code for free form and sculptured surfaces using CAM software.
12. Machining of simple components on NC lathe and Mill by transferring NC Code / from CAMsoftware.

#### EN606HS: ADVANCED COMMUNICATIONS SKILLS LAB

**B.Tech. III Year II Sem. L T P C**

#### 0 0 2 1

1. **INTRODUCTION:**

The introduction of the Advanced Communication Skills Lab is considered essential at 3rd year level. At this stage, the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalized context.

The proposed course should be a laboratory course to enable students to use ‘good’ English and perform the following:

* + Gathering ideas and information to organize ideas relevantly and coherently.
  + Engaging in debates.
  + Participating in group discussions.
  + Facing interviews.
  + Writing project/research reports/technical reports.
  + Making oral presentations.
  + Writing formal letters.
  + Transferring information from non-verbal to verbal texts and vice-versa.
  + Taking part in social and professional communication.

#### OBJECTIVES:

This Lab focuses on using multi-media instruction for language development to meet the following targets:

* + To improve the students’ fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakersand respond appropriately in different socio-cultural and professional contexts.
  + Further, they would be required to communicate their ideasrelevantly and coherently in writing.
  + To prepare all the students for their placements.

#### SYLLABUS:

The following course content to conduct the activities is prescribed for the Advanced English Communication Skills (AECS) Lab:

1. **Activities on Fundamentals of Inter-personal Communication and Building Vocabulary** - Starting a conversation – responding appropriately and relevantly – using the right body language

– Role Play in different situations & Discourse Skills- using visuals - Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy, idioms and phrases, collocations & usage of vocabulary.

1. **Activities on Reading Comprehension** –General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming, inferring meaning, critical reading& effectivegoogling.
2. **Activities on Writing Skills** – Structure and presentation of different types of writing – *letter writing/Resume writing/ e-correspondence/Technical report writing/* – planning for writing – improving one’s writing.
3. **Activities on Presentation Skills** – Oral presentations (individual and group) through JAM sessions/seminars/**PPTs** and written presentations through posters/projects/reports/e- mails/assignments etc.
4. **Activities on Group Discussion and Interview Skills** – Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and organizationof ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference & video-

conference and MockInterviews.

#### MINIMUM REQUIREMENT:

The Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

* + Spacious room with appropriate acoustics.
  + Round Tables with movable chairs
  + Audio-visual aids
  + LCD Projector
  + Public Address system
  + P – IV Processor, Hard Disk – 80 GB, RAM–512 MB Minimum, Speed – 2.8 GHZ
  + T. V, a digital stereo & Camcorder
  + Headphones of High quality

#### SUGGESTED SOFTWARE:

The software consisting of the prescribed topics elaborated above should be procured and used.

* + Oxford Advanced Learner’s Compass, 7th Edition
  + DELTA’s key to the Next Generation TOEFL Test: Advanced Skill Practice.
  + Lingua TOEFL CBT Insider, by Dream tech
  + TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS)

#### TEXT BOOKS:

1. Effective Technical Communication by M Asharaf Rizvi. McGraw Hill Education (India) Pvt. Ltd.2nd Edition
2. Academic Writing: A Handbook for International Students by Stephen Bailey, Routledge, 5thEdition.

#### REFERENCE BOOKS:

1. Learn Correct English – A Book of Grammar, Usage and Composition by Shiv K. Kumar andHemalatha Nagarajan. Pearson 2007
2. Professional Communication by Aruna Koneru, McGraw Hill Education (India) Pvt. Ltd, 2016.
3. Technical Communication by Meenakshi Raman & Sangeeta Sharma, Oxford University Press2009.
4. Technical Communication by Paul V. Anderson. 2007. Cengage Learning pvt. Ltd. New Delhi.
5. English Vocabulary in Use series, Cambridge University Press 2008.
6. Handbook for Technical Communication by David A. McMurrey & Joanne Buckley. 2012.Cengage Learning.
7. Communication Skills by Leena Sen, PHI Learning Pvt Ltd., New Delhi, 2009.
8. Job Hunting by Colm Downes, Cambridge University Press 2008.
9. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata Mc Graw-Hill 2009.

#### \*MC609: INTELLECTUAL PROPERTY RIGHTS

**B.Tech. III Year II Sem.` L T P C**

3 0 0 0

#### UNIT – I

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

#### UNIT – II

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

#### UNIT – III

Law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

#### UNIT – IV

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

#### UNIT – V

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

#### TEXT BOOKS & REFERENCE BOOKS:

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, TataMcGraw Hill Publishing company ltd.

#### \*MC611 ARTIFICIAL INTELLIGENCE

**B.Tech. III Year II Sem.` L T P C**

#### 3 0 0 0

**Course Objectives:** To train the students to understand different types of AI agents, various AI search algorithms, fundamentals of knowledge representation, building of simple knowledge-based systems and to apply knowledge representation, reasoning. Study of Markov Models enable the student readyto step into applied AI.

#### UNIT - I

**Introduction:** AI problems, Agents and Environments, Structure of Agents, Problem Solving Agents **Basic Search Strategies**: Problem Spaces, Uninformed Search (Breadth-First, Depth-First Search,Depth-first with Iterative Deepening), Heuristic Search (Hill Climbing, Generic Best-First, A\*), ConstraintSatisfaction (Backtracking, Local Search)

#### UNIT - II

**Advanced Search**: Constructing Search Trees, Stochastic Search, A\* Search Implementation,Minimax Search, Alpha-Beta Pruning

**Basic Knowledge Representation and Reasoning**: Propositional Logic, First-Order Logic, ForwardChaining and Backward Chaining, Introduction to Probabilistic Reasoning, Bayes Theorem

#### UNIT - III

**Advanced Knowledge Representation and Reasoning**: Knowledge Representation Issues, Non- monotonic Reasoning, Other Knowledge Representation Schemes

**Reasoning Under Uncertainty**: Basic probability, Acting Under Uncertainty, Bayes’ Rule,Representing Knowledge in an Uncertain Domain, Bayesian Networks

#### UNIT - IV

**Learning:** What Is Learning? Rote Learning, Learning by Taking Advice, Learning in Problem Solving, Learning from Examples, Winston’s Learning Program, Decision Trees.

#### UNIT - V

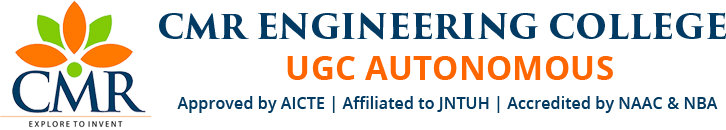
**Expert Systems:** Representing and Using Domain Knowledge, Shell, Explanation, KnowledgeAcquisition.

#### TEXT BOOK:

1. Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, Prentice-Hall, 2010.

#### REFERENCE BOOKS:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivasankar B. Nair, The McGraw Hill publications, Third Edition, 2009.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.



## B.Tech in MECHANICAL ENGINEERING

### COURSE STRUCTURE & SYLLABUS (R20)

**Applicable From 2020-21 Admitted Batch**

## YEAR I SEMESTER

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 | ME701PC | Refrigeration and Air Conditioning | 3 | 0 | 0 | 3 |
| 2 |  | **Professional Elective-II** | 3 | 0 | 0 | 3 |
| 3 |  | **Professional Elective-III** | 3 | 0 | 0 | 3 |
| 4 |  | **Professional Elective-IV** | 3 | 0 | 0 | 3 |
| 5 |  | **Open Elective-II / MOOCs** | 3 | 0 | 0 | 3 |
| 6 | ME702PC | Industry Oriented Mini Project | 0 | 0 | 4 | 2 |
| 7 | ME703PC | Seminar | 0 | 0 | 2 | 1 |
| 8 | ME704PC | Project Stage- I | 0 | 0 | 6 | 3 |
|  |  | **Total Credits** | 15 | 0 | 12 | **21** |

**IV YEAR II SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **S. No.** | **Course Code** | **Course Title** | **L** | **T** | **P** | **Credits** |
| 1 |  | **Professional Elective-V** | 3 | 0 | 0 | 3 |
| 2 |  | **Professional Elective-VI** | 3 | 0 | 0 | 3 |
| 3 |  | **Open Elective-III / MOOCs** | 3 | 0 | 0 | 3 |
| 4 | ME802PC | Project Stage- II | 0 | 0 | 14 | 7 |
|  |  | **Total Credits** | 9 | 0 | 14 | **16** |

#### ME701PC: REFRIGERATION AND AIR CONDITIONING

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**Pre-requisite**: Thermodynamics

**Course Objective**: To apply the principles of Thermodynamics to analyze different types of refrigeration and air conditioning systems and to understand the functionality of the major components.

**Course Outcomes**: At the end of the course, the student should be able to Differentiate between different types of refrigeration systems with respect to application as well as conventional and unconventional refrigeration systems. Thermodynamically analyse refrigeration and air conditioning systems and evaluate performance parameters. Apply the principles of Psychometrics to design the airconditioning loads for the industrial applications.

#### UNIT – I

**Introduction to Refrigeration:** - Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration – Types of Ideal cycle of refrigeration.

**Air Refrigeration:** Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system – Refrigeration needs of Air crafts- Air systems – Application of Air Refrigeration, Justification – Types of systems – Problems.

#### UNIT – II

Vapour compression refrigeration – working principle and essential components of the plant – Simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effectof sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – Problems.

#### UNIT - III

**System Components:** Compressors – General classification – comparison – Advantages and Disadvantages. Condensers – classification – Working Principles. Evaporators – classification – Working Principles. Expansion devices – Types – Working Principles. Refrigerants – Desirable properties – common refrigerants used – Nomenclature – Ozone Depletion – Global Warming – Azeotropes and Zeotropes.

#### UNIT - IV

Vapor Absorption System – Calculation of max COP – description and working of NH3 – water system – Li – Br system. Principle of operation Three Fluid absorption system, salient features. Steam Jet Refrigeration System – Working Principle and Basic Components

Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

#### UNIT – V

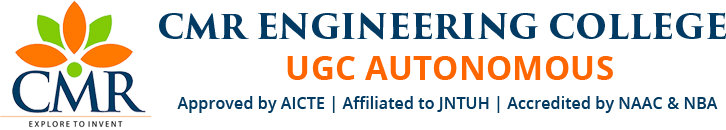
**Introduction to Air Conditioning:** Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF,ASHF, ESHF and ADP. Concept of human comfort and effective temperature –Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations. Air Conditioning systems - Classification of equipment, cooling, heating humidification anddehumidification, filters, grills and registers, deodorants, fans and blowers. Heat Pump – Heat sources – different heat pump circuits – Applications.

#### TEXT BOOKS:

1. Refrigeration and Air conditioning / CP Arora / Mc Graw Hill
2. Refrigeration and Air-Conditioning / RC Aora / PHI

#### REFERENCE BOOKS:

1. Principles of Refrigeration - Dossat / Pearson
2. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / Mc Graw Hill



## List of Professional Electives to be offered

**Applicable From 2020-21 Admitted Batch**

## Professional Elective – I

|  |  |
| --- | --- |
| ME511PE | Unconventional Machining Processes |
| ME512PE | Machine Tool Design |
| ME513PE | Production Planning and Control |

**Professional Elective – II**

|  |  |
| --- | --- |
| ME621PE | Industrial Management |
| ME622PE | Additive Manufacturing |
| ME623PE | Engineering Tribology |

## Professional Elective – III

|  |  |
| --- | --- |
| ME731PE | Power Plant Engineering |
| ME732PE | Automobile Engineering |
| ME733PE | Robotics |

**Professional Elective – IV**

|  |  |
| --- | --- |
| ME741 PE | Renewable Energy Sources |
| ME742PE | Computational Fluid Dynamics |
| ME743PE | Mechanical Vibrations |

## Professional Elective – V

|  |  |
| --- | --- |
| ME851PE | CNC Technology |
| ME852PE | Automation in Manufacturing |
| ME853PE | Turbo Machinery |

**Professional Elective – VI**

|  |  |
| --- | --- |
| ME861PE | Plant Layout & Material Handling |
| ME862PE | Composite Materials |
| ME863PE | Fluid Power System |

#### ME511PE: UNCONVENTIONAL MACHINING PROCESSES (Professional Elective - I)

**B.Tech. III Year II Sem. L T P C**

#### 3 0 0 3

**Course Overview:** The objective of this course is to introduce the student to more advanced topics in the machining processes. To bring out the need for Unconventional Machining Processes which will overcome the difficulties associated with Traditional Machining.

#### Course Objectives:

* To teach the modeling technique for machining processes
* To teach interpretation of data for process selection
* To teach the mechanics and thermal issues associated with chip formation
* To teach the effects of tool geometry on machining force components and surface finish
* To teach the machining surface finish and material removal rate

#### Course Outcomes:

* Understand the basic techniques of Unconventional Machining processes modeling
* Estimate the material removal rate and cutting force, in an industrially useful manner, forUnconventional Machining processes.

#### UNIT – I

**Introduction** – Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications.

Ultrasonic machining – Elements of the process, mechanics of metal removal process, parameters, economic considerations, applications and limitations, recent development.

#### UNIT - II

**Abrasive Jet Machining, Water Jet Machining And Abrasive Water Jet Machining**: Basic principles, equipment, process variable, and mechanics of metal removal, MRR, application and limitations.

**Electro – Chemical Processes**: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring processes, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate.

#### UNIT – III

**Thermal Metal Removal Processes**: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surfaceand machine tool selection. Wire EDM, principle, applications.

#### UNIT – IV

Generation and control of electron beam for machining, theory of electron beam machining, comparisonof thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

#### UNIT - V

Application of plasma for machining, metal removing mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining – principle - maskants - applications.

Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, shaped tube electrolyte machining.

#### TEXT BOOKS:

1. Advanced Machining Processes / VK Jain / Allied publishers
2. Modern Machining Processes - P. C. Pandey, H. S. Shan/ Mc Graw Hill

#### REFERENCE BOOKS:

1. Unconventional Manufacturing Processes/ Singh M.K/ New Age Publishers
2. Advanced Methods of Machining/ J.A. McGeough/ Springer International
3. Non-Traditional Manufacturing Processes/ Benedict G.F./ CRC Press

#### ME512PE: MACHINE TOOL DESIGN (Professional Elective – I)

**B.Tech. III Year II Sem. L T P C**

#### 3 0 0 3

**Pre-requisites:** Machine Design, Machine Tools and Metrology, Machining Science

**Course Objectives:** This course is designed to:

* Implement the tool design process when designing tooling for the manufacturing of a product.
* Apply Geometric Tolerancing principles in the designs of tooling.
* Evaluate and select appropriate materials for tooling applications.
* Design, develop and evaluate cutting tools and work holders for a manufactured product.
* Design, develop and evaluate appropriate Gauging systems to define limits and specificationsof a work piece during the manufacturing process.
* Design, develop, and evaluate tooling for various joining processes.
* Apply ANSI standards to tool design drawings and layouts.
* Use CAD and conventional techniques in creating tooling drawings.

**Course Outcomes:** At the end of the course, the student will be able to, understand basic motions involved in a machine tool, design machine tool structures, design and analyze systems for specified speeds and feeds, select subsystems for achieving high accuracy in machining, understand control strategies for machine tool operations and apply appropriate quality tests for quality assurance.

#### UNIT - I

Introduction to Machine Tool Drives and Mechanisms: Introduction to the course, Working and AuxiliaryMotions in Machine Tools, Kinematics of Machine Tools, Motion Transmission.

#### UNIT - II

Regulation of Speeds and Feeds: Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, FeedDrives, Feed Box Design.

#### UNIT - III

Design of Machine Tool Structures: Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriages.

#### UNIT - IV

Design of Guideways, Power Screws and Spindles: Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slideways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws.

Design of Spindles and Spindle Supports: Functions of Spindles and Requirements, Effect of MachineTool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings.

#### UNIT - V

Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness Acceptance Tests

#### TEXT BOOKS:

1. Tool Design/ Donaldson/ Fifth Edition, McGraw Hill
2. Principles of Machine Tools/ G.C. Sen and A. Bhattacharyya **/**New Central Book Agency

#### REFERENCE BOOKS:

1. Design of Machine Tools / D. K Pal, S. K. Basu / Oxford
2. Machine Tool Design and Numerical Control/ N.K. Mehta / Mc Graw Hill
3. Metal Cutting and Tool Design/ Ranganath B.J./ Vikas Publishers
4. Fundamentals of Tool Design/ ASTME, PHI
5. Tooling Data/ Joshi P.H./ Wheeler Publishing

#### ME513PE: PRODUCTION PLANNING AND CONTROL (Professional Elective – I)

**B.Tech. III Year II Sem. L T P C**

#### 3 0 0 3

**Pre-requisites:** Management Science & Productivity.

**Course Objectives**: Understand the importance of Production planning & control. Learning way of carrying out various functions so as to produce right product, right quantity at right time with minimum cost.

**Course Outcomes:** At the end of the course, the student will be able to understand production systems and their characteristics. Evaluate MRP and JIT systems against traditional inventory control systems. Understand basics of variability and its role in the performance of a production system. Analyze aggregate planning strategies. Apply forecasting and scheduling techniques to production systems. Understand theory of constraints for effective management of production systems.

#### UNIT – I

**Introduction**: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.

**Forecasting** – Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques.Measures of forecasting errors.

#### UNIT – II

**Inventory management** – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only. **Aggregate planning –** Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

#### UNIT – III

**Line Balancing**: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.

Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

#### UNIT – IV

**Scheduling** –Definition – Scheduling Policies – types of scheduling methods – differences with loading

– flow shop scheduling **–** job shop scheduling, line of balance (LOB) – objectives - steps involved.

#### UNIT – V

**Dispatching**: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

**Follow up**: definition – types of follow up – expediting – definition – expediting procedures- Applicationsof computers in planning and control.

#### TEXT BOOKS:

1. Operations management – Heizer- Pearson.
2. Production and Operations Management / Ajay K Garg / Mc Graw Hill.

#### REFERENCE BOOKS:

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control- Jain & Jain – Khanna publications

#### ME621PE: INDUSTRIAL MANAGEMENT (PE – II)

**B.Tech. IV Year II Sem. L T P C**

#### 3 0 0 3

**Prerequisites**: None

#### Course objectives:

* Understand the philosophies of management gurus
* Understand the various types of organization structures and their features, and Theiradvantages and disadvantages.
* Learning various Industrial Engineering Practices like Operations Management techniques,work study, statistical quality control techniques, Job evaluation techniques and network analysis techniques.

#### Course outcomes:

* Able to apply principles of management
* Able to design the organization structure
* Able to apply techniques for plant location, design plant layout and value analysis
* Able to carry out work study to find the best method for doing the work and establish standardtime for a given method
* Able to apply various quality control techniques and sampling plans
* Able to do job evaluation and network analysis.

#### UNIT - I

**Introduction to Management:** Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor’s Scientific Management Theory, Fayol’s Principlesof Management, Maslow’s Theory of Human Needs, Douglas McGregor’s Theory X and Theory Y, Herzberg’s Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

#### UNIT - II

**Designing Organizational Structures**: Departmentalization and Decentralization, Types of Organization structures – Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundaryless organization, inverted pyramid structure, lean and flat organization structureand their merits, demerits and suitability.

#### UNIT - III

**Operations Management**: Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production), Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts- Design of product layout- Line balancing (RPW method) Valueanalysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

#### UNIT - IV:

**Work Study:** Introduction — definition — objectives — steps in work study — Method study

— definition, objectives — steps of method study. Work Measurement — purpose — types of study — stop watch methods — steps — key rating — allowances — standard time calculations

— work sampling.

**Statistical Quality Control:** variables-attributes, Shewart control charts for variables- chart, R chart,

– Attributes- Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

#### UNIT - V

**Job Evaluation:** Methods of job evaluation — simple routing objective systems — classification

method factor comparison method, point method, benefits of job evaluation and limitations. **Project Management (PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost

Analysis, Project Crashing. (simple problems)

#### TEXT BOOKS

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma/Khanna Publishers.

#### REFERENCE BOOKS

1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study by lLO.
2. Human factors in Engineering & Design/Ernest J McCormick /TMH.
3. Production & Operation Management /Paneer Selvam/PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Hand Book/Maynard.
6. Industrial Engineering Management I Ravi Shankar/Galgotia.

#### ME622PE: ADDITIVE MANUFACTURING TECHNOLOGY (PE - II)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**Pre-requisites:** Manufacturing process, Engineering Materials

#### Course Objectives:

* To understand the fundamental concepts of Additive Manufacturing (i.e. Rapid Prototyping) and 3-D printing, its advantages and limitations.
* To classify various types of Additive Manufacturing Processes and know theirworking principle, advantages, limitations etc.
* To have a holistic view of various applications of these technologies in relevant fieldssuch as mechanical, Bio-medical, Aerospace, electronics etc.

#### Course Outcomes:

* Describe various CAD issues for 3D printing and rapid prototyping and related operations for STL model manipulation.
* Formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline-based surface fitting.
* Formulate and solve typical problems on reverse engineering for surface reconstruction from digitized mesh models through topological modelling and subdivision surface fitting.
* Explain and summarize the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing and additive manufacturing systems.
* Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts.

#### UNIT - I

**Introduction:** Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages, and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.

#### UNIT - II

**Liquid-based Rapid Prototyping Systems:** Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies Solid-based Rapid

Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

#### UNIT - III

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing

(3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification; Indirect Rapid Tooling Methods:

Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling :

Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

#### UNIT - IV

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software’s: Features of various RP software’s like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

#### UNIT - V

RP Applications : Application - Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

#### TEXT BOOKS:

1. Rapid prototyping; Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific Publications
2. Rapid Manufacturing /D.T. Pham and S.S. Dimov/Springer

#### REFERENCE BOOKS:

1. Terry Wohlers, Wholers Report 2000, Wohlers Associates
2. Rapid Prototyping and Manufacturing /PaulF.Jacobs/ASME

#### ME623PE: ENGINEERING TRIBOLOGY (PE – II)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**Pre-requisites**: Fluid mechanics, Design of machine members-II

#### Course objectives:

* To expose the student to different types of bearings, bearing materials,
* To understand friction characteristics and power losses in journal bearings.
* To learn theory and concepts about different types of lubrication.

#### Course Outcomes:

* Understanding friction characteristics in journal bearings.
* Knowledge about different theories of lubrication to reduce friction and wear.

#### UNIT – I

Study of various parameters: Viscosity, flow of fluids, viscosity and its variation, absolute and kinematic viscosity, temperature variation, viscosity index, determination of viscosity, different viscometers used. Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

#### UNIT – II

Hydrodynamic theory of lubrication: Various theories of lubrication, petroffs equation, Reynold’s equation in two dimensions -Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydro-dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing.

#### UNIT – III

Friction and power losses in journal bearings: Calibration of friction loss, friction in concentric bearings, bearing moduIus, Sommer-field number, heat balance, practical consideration of journal bearing design considerations.

#### UNIT – IV

Air lubricated bearing: Advantages and disadvantages, application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect. Study of current concepts of boundary friction and dry friction.

#### UNIT - V

Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings.

**Bearing materials:** General requirements of bearing materials, types of bearing materials.

#### TEXT BOOKS:

1. Fundamentals of Tribology, Basu, Sen Gupta and Ahuja /PHI
2. Tribology in Industry: Sushil Kumar Srivatsava, S. Chand & Co.

#### REFERENCE BOOK:

1. Introduction to Tribology of Bearings – B.C. Majumdar/ S. Chand

#### ME731PE: POWER PLANT ENGINEERING (PE – III)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**Pre-Requisites:** None

**Course Objective:** The goal of this course is to become prepared for professional engineering designof conventional and alternative power-generation plants. The learning objectives include

* Analysis and preliminary design of the major systems of conventional fossil-fuel steam- cyclepower plants.
* A working knowledge of the basic design principles of nuclear, gas turbine, combined cycle,hydro, wind, geothermal, solar, and alternate power plants.
* Awareness of the economic, environmental, and regulatory issues related to power generation.

**Course Outcomes:** At the end of the course students are able to:

* Understand the concept of Rankine cycle.
* Understand working of boilers including water tube, fire tube and high pressure boilers anddetermine efficiencies.
* Analyze the flow of steam through nozzles
* Evaluate the performance of condensers and steam turbines
* Evaluate the performance of gas turbines

#### UNIT – I

Introduction to the Sources of Energy – Resources and Development of Power in India.

**Steam Power Plant:** Plant Layout, Working of different Circuits, Fuel and handling equipments, typesof coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.

**Combustion Process:** Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heatrejection. Corrosion and feed water treatment.

#### UNIT – II

**Internal Combustion Engine Plant:** Diesel Power Plant: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.

**Gas Turbine Plant:** Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

#### UNIT – III

**Hydro Electric Power Plant:** Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.

**Hydro Projects and Plant:** Classification – Typical layouts – plant auxiliaries – plant operation pumpedstorage plants.

#### UNIT – IV

**Nuclear Power Station:** Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation. **Types of Reactors:** Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

#### UNIT – V

**Power Plant Economics and Environmental Considerations**: Capital cost, investment of fixed

charges, operating costs, general arrangement of power distribution, Load curves, load duration curve.Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises.

Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

#### TEXT BOOKS:

1. Power Plant Engineering/ P. K. Nag / Mc Graw Hill
2. Power Plant Engineering / Hegde / Pearson.

#### REFERENCES BOOKS:

1. Power Plant Engineering / Gupta / PHI
2. Power Plant Engineering / A K Raja / New age

#### ME732PE: AUTOMOBILE ENGINEERING (PE – III)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**UNIT - I**

**Introduction:** Layout of automobile – introduction chassis and body components. Types of Automobileengines. – Power unit – Introduction to engine lubrication – engine servicing

**Fuel System:** S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

**Engines:** Requirements of diesel injection systems, types of injection systems, DI Systems IDIsystems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction to CRDI and TDI Systems.

#### UNIT - II

**Cooling System:** Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling

– pressure sealed cooling – antifreeze solutions.

**Ignition System:** Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser, and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

**Electrical System:** Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, enginetemperature indicator etc.

#### UNIT - III

**Transmission System:** Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, constant mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

**Suspension System:** Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

#### UNIT - IV

**Braking System:** Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

**Steering System:** Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

#### UNIT - V

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives

– Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels, and gaseous fuels, Hydrogen as a fuel for IC Engines. - Their merits and demerits. Standard Vehicle maintenance practice.

#### TEXT BOOKS:

1. Automobile Engineering / William H Crouse
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi & Yosuf Ali, FrontlinePublications.

#### REFERENCE BOOKS:

1. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner
3. Automotive Engineering / Newton Steeds & Garrett
4. Automotive Engines / Srinivasan
5. A Text Book of Automobile Engineering By Khalil U Siddiqui New Age International

#### ME733PE: ROBOTICS (PE – III)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**Pre-requisites:** Basic principles of Kinematics and mechanics

**Course Objectives:** The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

* Make the students acquainted with the theoretical aspects of Robotics
* Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
* Make the students to understand the importance of robots in various fields of engineering.
* Expose the students to various robots and their operational details.

**Course Outcomes:** At the end of the course, the student will be able to understand the basic components of robots. Differentiate types of robots and robot grippers. Model forward and inverse kinematics of robot manipulators. Analyze forces in links and joints of a robot. Programme a robot to perform tasks in industrial applications. Design intelligent robots usingsensors.

#### UNIT – I

**Introduction:** Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications.

**Components of the Industrial Robotics:** common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

#### UNIT – II

**Motion Analysis:** Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

**Manipulator Kinematics**-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulation.

#### UNIT – III

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

#### UNIT IV

**Robot actuators and Feedback components:**

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.

#### UNIT V

**Robot Application in Manufacturing:**

Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

#### TEXT BOOKS:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

#### REFERENCE BOOKS:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada , Slotine / Wiley Inter-Science

#### ME741PE: RENEWABLE ENERGY SOURCES (PE – IV)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**Course Objectives:**

* To explain the concepts of Non-renewable and renewable energy systems
* To outline utilization of renewable energy sources for both domestic and industrial applications
* To analyse the environmental and cost economics of renewable energy sources in comparisonwith fossil fuels.

#### Course Outcomes:

* Understanding of renewable energy sources
* Knowledge of working principle of various energy systems
* Capability to carry out basic design of renewable energy systems

#### UNIT-I

**Global and National Energy Scenario:** Over view of conventional & renewable energy sources, need& development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO2 reduction potential of renewable energy- concept of Hybrid systems.

#### UNIT-II

**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

#### UNIT-III

**Wind Energy:** Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill componentdesign, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

#### UNIT-IV

**Biogas:** Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

#### UNIT-V

**Ocean Energy:** Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, typesof turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy**: Geothermal power plants, various types, hot springs and steam ejection.

#### TEXT BOOKS:

1. Renewable Energy Sources / Twidell, J.W. and Weir, A./ EFN Spon Ltd., 1986.
2. Non-Conventional Energy Sources / G.D Rai/ Khanna Publishers

#### REFERENCE BOOKS:

1. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press,U.K, 1996.

#### ME742PE: COMPUTATIONAL FLUID DYNAMICS (PE – IV)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**Pre-requisite:** Heat Transfer and Fluid Mechanics

**Course Objective:** To apply the principles of Heat Transfer and Fluid Mechanics to formulate governingequations for physical problems and to solve those using different numerical techniques

**Course Outcomes:** At the end of the course, the student should be able to:

* Differentiate between different types of Partial Differential Equations and to know and understand appropriate numerical techniques.
* Solve the simple heat transfer and fluid flow problems using different numerical techniques,viz., FDM.
* Understand and to appreciate the need for validation of numerical solution.

#### UNIT - I:

Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., - Main working principle - CFD as a research and design tool

– Applications in various branches of Engineering

Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its significance in understanding the physical and numerical aspects of the PDE – One way and Two Way variables – Well posed problems – Initial and Boundary Conditions

Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition

– Pivoting – Treatment of Banded Matrices – Thomas Algorithm Iterative Method: Gauss Seidel and Jordan Methods - Stability Criterion

#### UNIT - II:

Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order andsecond order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beams etc., - Solutions –Treatment of Curvelinear coordinates – Singularities – Finite Difference Discretization Solution of 1D heat conduction problems in Heat conduction in curve linear coordinates

#### UNIT - III:

FDM: Solution of physical problems with Parabolic type of Governing Equations – Initial Condition – Explicit, implicit and semi implicit methods – Types of errors – Stabilityand Consistency

* Von NeumannStability criterion– Solution of simple physical problems in 1D and 2D – Transient Heat conduction problems- ADI scheme - Simple Hyperbolic type PDE - First order and Second order wave equations –Discretization using Explicit method - Stability criterion – Courant Number
* CFL Condition - Its significance - Treatment of simple problems

#### UNIT - IV:

Finite Difference Solution of Unsteady Inviscid Flows: Lax – Wendroff Technique – Disadvantages – Maccormack’s Technique

Fluid Flow Equations – Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation – Finite Difference treatment of Lid Driven Cavity Problem -Application to Cylindrical Coordinates with example of flow over infinitely long cylinder

and sphere – Obtaining Elliptic Equations

#### UNIT - V:

Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger’s Equation – Discretization using FTCS method with respect to Upwind Scheme and TransportProperty – Upwind

Scheme and Artificial Viscosity

Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid – Marker and Cell (MAC) Formulation – Numerical Stability Considerations – Pressure correction method - SIMPLE Algorithm

#### TEXT BOOKS:

1. Computational Fluid Dynamics: The basics with applications/ John D Anderson/McGraw HillPublications
2. Numerical Heat Transfer and Fluid Flow/ S.V. Patankar/ Mc Graw Hill

#### REFERENCE BOOKS:

1. Computational Fluid Flow and Heat Transfer / K Muralidharan and T Sudarajan/ NarosaPublishers.
2. Computational Methods for Fluid Dynamics / Firziger & Peric/ Springer

#### ME743PE: MECHANICAL VIBRATIONS (PE – IV)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**Pre-requisites:** Engineering Mechanics

**Course objectives:** Understand various levels of vibrations and remedies for each of them.

**Course Outcomes:** At the end of the course, the student will be able to, Understand the causes and effects of vibration in mechanical systems. Develop schematic models for physical systems and formulate governing equations of motion. Understand the role of damping, stiffness and inertia in mechanical systems Analyze rotating and reciprocating systems and compute critical speeds. Analyzeand design machine supporting structures, vibration isolators and absorbers.

#### UNIT - I

**Single degree of Freedom systems - I:** Undamped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolationand transmissibility.

#### UNIT - II

**Single degree of Freedom systems - II:** Response to Non-Periodic Excitations: unit impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

#### UNIT - III

**Two-degree freedom systems:** Principal modes- undamped and damped free and forced vibrations;undamped vibration absorbers;

**Multi degree freedom systems:** Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete- Time systems.

#### UNIT - IV

**Continuous system:** Free vibration of strings – longitudinal oscillations of bars- traverse vibrations ofbeams- Torsional vibrations of shafts.

**Critical speeds of shafts**: Critical speeds without and with damping, secondary critical speed. **Numerical Methods:** Rayleigh’s stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

#### UNIT - V

**Sound level and subjective response to sound:** Subjective response to sound, frequency dependent human response to sound, sound-pressure dependent human response, the decibel scale, relationship among sound power, sound intensity and sound pressure level, relationship between sound power level and sound intensity, relationship between sound intensity level and sound pressure level, sound measuring instruments.

#### TEXT BOOKS:

1. Elements of Vibration Analysis / Meirovitch/ Mc Graw Hill
2. Principles of Vibration / Benson H. Tongue/Oxford

#### REFERENCE BOOKS:

1. Mechanical Vibrations / SS Rao / Pearson
2. Mechanical Vibration /Rao V. Dukkipati, J Srinivas/ PHI
3. Mechanical Vibrations/ G.K. Grover/ Nemchand & Brothers

#### ME852PE: CNC TECHNOLOGY (PE – V)

**B.Tech. IV Year II Sem. L T P C**

#### 3 0 0 3

**Course objectives**: Importance of CNC machines. Understand the fundamentals of it. Learning various methods of tooling the CNC machines. Various controlling methods, Learning the part programming

**Course outcomes:** At the end course, one should be able to select tooling method, control mechanism and do part programming for a given product.

#### UNIT - I

Features of NC machines: fundamentals of numerical control, advantage of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems, features of NC Machine tools, design consideration of NC machine tool, methods of improving machine accuracy.

CNC Machine elements: machine structures - Guide ways - feed drives-spindles- spindle bearings- measuring systems- tool mentoring systems.

#### UNIT - II

Tooling for CNC machines: interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, and quick change tooling system, automatic head changers.

NC part programming: manual programming-Basic concepts, point to point contour programming, canned cycles, parametric programming.

#### UNIT - III

Computer-Aided Programming: General information, APT programming, Examples Apt programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors. Introduction to CAD/CAM software, Automatic Tool Path generation.

#### UNIT - IV

DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, adaptive control with constraints, Adaptive control of machining processes like turning, grinding.

#### UNIT - V

Micro Controllers: Introduction, Hardware components, I/O pins, ports, external memory, counters, timers and serial data I/O interrupts selection of Micro Controllers, Embedded Controllers, Applications and Programming of Micro Controllers.

Programming Logic Controllers (PLC’S): Introduction, Hardware components of PLC, system, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC’S in CNC Machines.

#### TEXT BOOKS:

1. Computer Control of Manufacturing Systems/ Yoram Koren/ Mc Graw Hill
2. CNC Programming: Principles and Applications /Mattson/ Cengage

#### REFERENCE BOOKS:

1. Machining Tools Hand Book Vol 3/ Manfred Weck , John Wiley Mechatronics- HMT/ Mc Graw Hill .
2. Machining and CNC Technology / Michael Fitzpatrick / Mc Graw Hill.

#### ME852PE: AUTOMATION IN MANUFACTURING (PE – V)

**B.Tech. IV Year II Sem. L T P C**

#### 3 0 0 3

**UNIT - I**

**Introduction:** Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and too changing and machine tool control transfer the automaton.

#### UNIT - II

**Automated flow lines**: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

**Analysis of Automated flow lines**: General terminology and analysis of transfer lines without and withbuffer storage, partial automation, implementation of automated flow lines.

#### UNIT - III

**Assembly system and line balancing**: Assembly process and systems assembly line, line balancingmethods, ways of improving line balance, flexible assembly lines.

#### UNIT - IV

**Automated material handling:** Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems.

Automated storage systems, Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

#### UNIT -V

**Fundamentals of Industrial controls:** Review of control theory, logic controls, sensors and actuators,Data communication and LAN in Manufacturing.

Business process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE.

#### TEXT BOOK:

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover 3e./PE/PHI, 2009.

#### REFERENCE BOOKS:

1. Computer Aided Manufacturing, Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang,Pearson, 2009.
2. Automation by W. Buekinsham.

#### ME853PE: TURBO MACHINERY (PE – IV)

**B.Tech. IV Year II Sem. L T P C**

#### 3 0 0 3

**Pre-requisites:** Thermal Engineering, Heat Transfer

#### Course Objectives:

* Provide students with opportunities to apply basic flow equations
* Train the students to acquire the knowledge and skill of analyzing different turbo machines.
* How to compare and chose machines for various operations

#### Course Outcomes:

* Ability to design and calculate different parameters for turbo machines
* Prerequisite to CFD and Industrial fluid power courses
* Ability to formulate design criteria
* Ability to understand thermodynamics and kinematics behind turbo machines

#### UNIT - I

**Introduction to Turbomachinery:** Classification of turbo-machines, second law of thermodynamics applied to turbine and compressors work, nozzle, diffuser work, fluid equation, continuity, Euler‘s, Bernoulli‘s, equation and its applications, expansion and compression process, reheat factor, preheat factor

#### UNIT - II

**Fundamental Concepts of Axial and Radial Machines:** Euler‘s equation of energy transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje‘s slip factor, suction pressure and net positive suction head, phenomena of cavitation in pumps, concept of specific speed, shape number, axial, radial and mixed flow machines, similarity laws.

#### UNIT - III

**Gas Dynamics**: Fundamental thermodynamic concepts, isentropic conditions, mach numbers, and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow, oblique shock waves. Normal shock recoveries, detached shocks, Aerofoil theory.

**Centrifugal compressor**: Types, Velocity triangles and efficiencies, Blade passage design, Diffuser and pressure recovery. Slip factor, Stanitz and Stodolas formula's, Effect of inlet mach numbers, Pre whirl, Performance

#### UNIT - IV

**Axial Flow Compressors**: Flow Analysis, Work, and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance

**Cascade Analysis**: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

#### UNIT - V

**Axial Flow Gas Turbines**: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifels relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuatordisc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

#### TEXT BOOKS:

1. Principles of Turbo Machines/DG Shepherd / Macmillan
2. Turbines, Pumps, Compressors/Yahya/ Mc Graw Hill

#### REFERENCE BOOKS:

1. A Treatise on Turbo machines / G. Gopal Krishnan *and* D. Prithviraj/ SciTech
2. Gas Turbine Theory/ Saravanamuttoo/ Pearson
3. Turbo Machines/ A Valan Arasu/ Vikas Publishing House Pvt. Ltd.

#### ME861PE : PLANT LAYOUT AND MATERIAL HANDLING (PE – VI)

**B.Tech. IV Year II Sem. L T P C**

#### 3 0 0 3

**Pre –requisites :** MANUFACTURING TECHNOLOGY – I

#### Course objectives:

To equip students with adequate knowledge for running an organization and to understand the integration of material handling systems.

#### Course Outcomes:

* Understand the flow and type of movement of industrial goods
* Apply general rules for the type of movement, and
* Identify the appropriate material handling systems to suit the said requirement
* Design of material handling system

#### UNIT – I

Introduction- Classification of Layout, Advantages and Limitations of different layouts, Layout design procedures, Overview of the plant layout.

Process layout & Product layout: Selection, specification, Implementation and follow up, comparison of product and process layout.

#### UNIT – II

Heuristics for Plant layout – ALDEP, CORELAP, CRAFT, Group Layout, Fixed position layout- Quadratic assignment model. Branch and bound method

#### UNIT – III

Introduction, Material Handling systems, Material Handling principles, Classification of Material Handling Equipment, Relationship of material handling to plant layout.

#### UNIT – IV

Basic Material Handling systems: Selection, Material Handling method- path, Equipment, function oriented systems.

#### UNIT – V

Methods to minimize cost of material handling- Maintenance of Material Handling Equipments, Safety in handling Ergonomics of Material Handling equipment. Design, Miscellaneous equipments.

#### TEXT BOOKS:

1. Operations Management/ PB Mahapatra/PHI.
2. Aspects of Material handling/ Dr. KC Arora & Shinde/ Lakshmi Publications.

#### REFERENCES:

1. Facility Layout & Location an analytical approach/ RL Francis/ LF Mc Linnis Jr, White/ PHI.
2. Production and Operations Management/ R Panneerselvam/ PHI.
3. Introduction to Material handling/ Ray, Siddhartha/ New Age.
4. Plant Layout and Material Handling/RB Chowdary/Khanna Publishers.
5. Plant Maintenance and Reliability Engineering/NVS Raju/Cengage Learning.

#### ME862PE: COMPOSITE MATERIALS (PE – VI)

**B.Tech. IV Year II Sem. L T P C**

#### 3 0 0 3

**Course objectives:**

* Develop understanding of the structure of ceramic materials on multiple length scales.
* Develop knowledge of point defect generation in ceramic materials, and their impact ontransport properties.
* To describe key processing techniques for producing metal, ceramic-, and polymer- matrixcomposites.
* To demonstrate the relationship among synthesis, processing, and properties in compositematerials.

#### Course Outcomes:

* Knowledge of the crystal structures of a wide range of ceramic materials and glasses.
* Able to explain how common fibers are produced and how the properties of the fibers arerelated to the internal structure.
* Able to select matrices for composite materials in different applications.
* Able to describe key processing methods for fabricating composites.

#### UNIT - I

Introduction: Definition, Classification of Composite materials based on structure, based on matrix, Advantages of composites, Applications of composites, Functional requirements of reinforcement and matrix.

#### UNIT - II

Types of reinforcements and their properties: Fibers: Carbon, Boron, Glass, Aramid, Al2O3, SiC, Nature and manufacture of glass, carbon and aramid fibres, Comparison of fibres. Role of interfaces: Wettability and Bonding, The interface in Composites, Interactions and Types of bonding at the Interface, Tests for measuring Interfacial strength.

#### UNIT - III

Fabrication of Polymeric Matrix Composites, Structure and properties of Polymeric Matrix Composites, Interface in Polymeric Matrix Composites, Applications; Fabrication of Ceramic Matrix Composites, Properties of Ceramic Matrix Composites, Interface in Ceramic Matrix Composites, Toughness of Ceramic Matrix Composites Applications of Ceramic Matrix Composites.

#### UNIT - IV

Fabrication of Metal Matrix Composites: Solid state fabrication, Liquid state fabrication and In-situ fabrication techniques; Interface in Metal Matrix Composites: Mechanical bonding, Chemical bonding and Interfaces in In-situ Composites; Discontinuously reinforced Metal Matrix Composites, Properties and Applications. Fabrication of Carbon fiber composites, properties, interface and applications.

#### UNIT - V

Micromechanics of Composites: Density, Mechanical Properties: Prediction of Elastic constants, Micro mechanical approach, Halpin-Tsai equations, Transverse stresses; Thermal properties: Hydrothermal stresses and Mechanics of Load transfer from matrix to fiber.

#### TEXTS BOOKS:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.
2. An Introduction to Composite Materials*,* Hull, Cambridge, 2nd Edt. 1997.

#### REFERENCE BOOKS:

1. Composites, Engineered Materials Handbook, Vol. 1, ASM International, Ohio, 1988.
2. Structure and Properties of Composites, Materials Science and Technology, Vol. 13, VCH,Weinheim, Germany, 1993
3. Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman& Hall, London, 1994

#### ME863PE: FLUID POWER SYSTEMS (PE – VI)

**B.Tech. IV Year II Sem. L T P C**

#### 3 0 0 3

**Pre-requisites**: Fluid Mechanics and Hydraulics Machinery

**Course outcomes:** After doing this, student should be able to

* Understand the Properties of fluids, Fluids for hydraulic systems,
* governing laws. distribution of fluid power, Design and analysis of typical hydraulic circuits.
* Know accessories used in fluid power system, Filtration systems and
* maintenance of system.

#### UNIT- I

Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations. ISO symbols, energy losses in hydraulic systems. Applications, Basic types and constructions of Hydraulic pumps and motors. Pump and motor analysis. Performan curves and parameters.

#### UNIT- II

Hydraulic actuators, types and constructional details, lever systems, control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves. Flapper valve Analysis and Design.

#### UNIT- III

Proportional control valves and servo valves. Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Design and analysis of typical hydraulic circuits. Regenerative circuits, high low circuits, Synchronization circuits, and accumulator sizing.

#### UNIT- IV

Intensifier circuits Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits, accessories used in fluid power system, Filtration systems and maintenance of system. Components of pneumatic systems; Direction, flow and pressure control valves in pneumatic systems. Development of single and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling;

#### UNIT- V

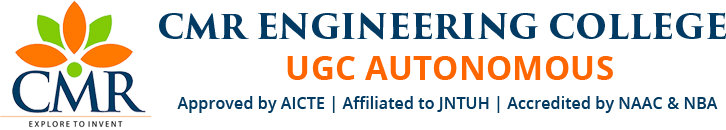
Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Will-dependent control, Travel-dependent control and Time dependent control, combined control, Program Control, Electropneumatic control and air-hydraulic control, Ladder diagrams. Applications in Assembly, Feeding, Metal working, materials handling and plastics working.

#### TEXT BOOKS:

1. Fluid Power Control systems/ Pippenger, J.J., and R. M. Koff/ New York: McGraw Hill.
2. “Fluid Power Systems: modeling, simulation and microcomputer control”/ John Watton/ Prentice Hall International.

#### REFERENCE BOOKS:

1. Fundamentals of Fluid Power Control. / John Watton/ 1 st Ed. Cambridge University Press,2009
2. “Fluid Power with applications”/ Anthony Esposito / Pearson Education.



## List of Open Electives to be offered

**Applicable From 2020-21 Admitted Batch**

## Open Elective-I

|  |  |  |
| --- | --- | --- |
| 1 | ME611OE | Industrial Robotics |
| 2 | ME612OE | Non-Conventional Sources of Energy |
| 3 | ME613OE | Basic Mechanical Engineering |

**Open Elective-II**

|  |  |  |
| --- | --- | --- |
| 1 | ME721OE | Operations Research |
| 2 | ME722OE | Total Quality Management |
| 3 | ME723OE | Measuring Instruments |

## Open Elective-III

|  |  |  |
| --- | --- | --- |
| 1 | ME831OE | Principles of Entrepreneurship |
| 2 | ME832OE | Engineering Materials |
| 3 | ME833OE | Linear and Non-Linear Optimization Techniques |

#### ME611OE: INDUSTRIAL ROBOTICS (Open Elective – I)

**B.Tech. III Year II Sem. L T P C**

#### 3 0 0 3

**Pre-requisites:** Basic principles of Kinematics and mechanics

**Course Objectives:** The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

* Make the students acquainted with the theoretical aspects of Robotics
* Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
* Make the students to understand the importance of robots in various fields of engineering.
* Expose the students to various robots and their operational details.

**Course Outcomes:** At the end of the course, the student will be able to understand the basic components of robots. Differentiate types of robots and robot grippers. Model forward and inverse kinematics of robot manipulators. Analyze forces in links and joints of a robot. Programme a robot to perform tasks in industrial applications. Design intelligent robots using sensors.

#### UNIT – I

**Introduction:** Automation and Robotics – An over view of Robotics – present and future applications. **Components of the Industrial Robotics:** common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

#### UNIT – II

**Motion Analysis:** Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems. **Manipulator Kinematics**-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulators.

#### UNIT – III

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion

– straight line motion.

#### UNIT - IV

**Robot actuators and Feedback components:** Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors – End Effectors and Tools

#### UNIT V

**Robot Application in Manufacturing:** Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection. Robotic Programming Methods – Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL.

#### TEXT BOOKS:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

#### REFERENCE BOOKS:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada, Slotine / Wiley Inter-Science
3. Robotics – Fu et al / TMH Publications.

#### ME612OE: NON-CONVENTIONAL SOURCES OF ENERGY (Open Elective – I)

**B.Tech. III Year II Sem. L T P C**

#### 3 0 0 3

**Pre-requisites:** None

**Course Outcomes:** At the end of the course, the student will be able to:

* Identify renewable energy sources and their utilization. Understand the basic concepts of solar radiation and analyze the working of solar and thermal systems.
* Understand principles of energyconversion from alternate sources including wind, geothermal, ocean, biomass, biogas and hydrogen.
* Understand the concepts and applications of fuel cells, thermoelectric convertor and MHD generator.
* Identify methods of energy storage for specific applications

#### UNIT – I

**Principles of Solar Radiation**: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power - Physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, Solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

**Solar Energy Collection:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

#### UNIT - II

**Solar Energy Storage and Applications:** Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications - solar heating/cooling techniques, solar distillation and drying,photovoltaic energy conversion.

**Wind Energy:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

#### UNIT - III

**Bio-Mass:** Principles of Bio-Conversion, Anaerobic /aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of biogas, utilization for cooking, I.C. Engine operation, and economic aspects.

#### UNIT - IV

**Geothermal Energy:** Resources, types of wells, methods of harnessing the energy, potential in India. **Ocean Energy** – OTEC, Principles, utilization, setting of OTEC plants, thermodynamic cycles. Tidal and Wave energy: Potential and conversion techniques, mini-hydel power plants, their economics.

#### UNIT –V

**Direct Energy Conversion:** Need for DEC, Carnot cycle, limitations, Principles of DEC. Thermo- electric generators, Seebeck, Peltier and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principle, faraday’s laws, thermodynamic aspects, selection of fuels and operatingconditions.

#### TEXT BOOKS:

1. Renewable Energy Resources / Tiwari and Ghosal / Narosa
2. Non- conventional Energy Sources / G.D. Rai/ Khanna Publishers
3. Biological Energy Resources/ Malcolm Fleischer & Chris Lawis/ E&FN Spon.

#### REFERENCE BOOKS:

1. Renewable Energy Sources / Twidell & Weir
2. Solar Power Engineering / B.S. Magal Frank Kreith & J.F. Kreith
3. Principles of Solar Energy / Frank Krieth & John F Kreider
4. Non-Conventional Energy / Ashok V Desai / Wiley Eastern
5. Non-Conventional Energy Systems / K Mittal / Wheeler
6. Renewable Energy Technologies / Ramesh & Kumar / Narosa

#### ME613OE: BASIC MECHANICAL ENGINEERING (Open Elective – I)

**B.Tech. III Year II Sem. L T P C**

#### 3 0 0 3

**Course Objectives**

* To gain an understanding of the basic concepts of various aspects of Mechanical Engineering, fields of application, their merits, demerits, and limitations and applications.

#### UNIT - I

**Basic Concepts of Thermodynamics and Heat Transfer:** Definitions – continuum concept – properties

– point and path functions – systems – processes – thermodynamic equilibrium - laws of thermodynamic- First law applied to open and closed systems – steady and unsteady flow systems

- Second law – heat engines and heat pumps – efficiency and Coefficient of Performance (COP). Heat transfer – conduction – general conduction equation in Cartesian coordinates – conduction incomposite walls. Convection – free and forced convection – simple empirical correlations. Radiation –laws – black body and grey body radiation.

#### UNIT - II

**IC Engines and Air Conditioning:** I C engines – classification - construction and working - two and four stroke engines – S I and C.I. engines – powdered coal as an alternative to diesel fuel.

Air conditioning – air cycles, vapour compression cycle – vapour absorption cycle – psychrometric processes. Air cooling – methods and simple cooling load calculations. Systems applicable to mining environment.

#### UNIT - III

**Power Transmission:** Gears – nomenclature, laws of gearing, types of gears including rack and pinion, interference, gear trains, calculation of gear ratios, couplings - types, features and applications.

Basic concepts in hydraulic & pneumatic power and devices and their utilisation – simple calculations.

#### UNIT - IV

**Kinematics of Machines:** Mechanisms – basics – kinematic concepts and definitions – degree of freedom, mechanical advantage – transmission angle – description of common mechanisms – quick return mechanisms, straight line generators, dwell mechanisms, ratchets and escapements – universal joints.

Cams and followers – terminology and definitions, displacement diagrams – uniform velocity, parabolicand simple harmonic motions.

#### UNIT - V

**Rotodynamic and Vibratory Machines:** Fans and compressors – types, construction, working principle, characteristics and applications. Single stage and multistage air compressors – intercooling. Simple calculations for output and efficiency.

Vibration – Importance of free and forced vibration. Vibrators and shakers – construction, working principle, applications and limitations.

**Note:** HMT Data book to be permitted

#### TEXT BOOKS:

1. Elements of Mechanical Engineering/ S.N. Lal/ Cengage Learning
2. Theory of Machines and Mechanisms / Shigley J.E., Pennock G.R. and Uicker J. J./ Oxford University Press, 2003.

#### REFERENCE BOOKS:

1. Rajput, R.K. Thermal Engineering, 6th Edition, Laxmi Publications, 2007
2. Ballaney, P.L. Thermal Engineering, Khanna Publishers, 24th Edition, 2003

#### ME721OE: OPERATIONS RESEARCH (Open Elective – II)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**Prerequisites**: None

**Course Objectives:** Understanding the mathematical importance of development of model in a particular optimization model for the issue and solving it.

**Course Outcome:** Understanding the problem, identifying variables & constants, Formulation of optimization model and applying appropriate optimization technique

#### UNIT - I

Development-definition-characteristics and phases-Types of models-Operations Research models- applications.

**Allocation:** Linear Programming Problem Formulation-Graphical solution- Simplex method- Artificial variable techniques: Two-phase method, Big-M method.

#### UNIT - II

**Transportation problem** - Formulation-Optimal solution, unbalanced transportation problem- Degeneracy.

**Assignment problem**- Formulation-Optimal solution, - Variants of Assignment problem- Travelling salesman problem.

#### UNIT - III

**Sequencing-** Introduction-Flow-Shop sequencing- n jobs through two machines – n jobs through three machines- Job shop sequencing-two jobs through ‘m’ machines

**Replacement**: Introduction- Replacement of items that deteriorate with time- when money value is not counted and counted- Replacement of items that fail completely- Group Replacement.

#### UNIT - IV

**Theory of Games**: Introduction- Terminology- Solution of games with saddle points and without saddle points. 2 x 2 games- dominance principle- m x 2 & 2 x n games- Graphical method.

**Inventory**: Introduction- Single item, Deterministic models- purchase inventory models with one price break and multiple price breaks- Stochastic models \_ Demand may be discrete variable or continuous variable- single period model and no setup cost.

#### UNIT - V

**Waiting lines**: Introduction- Terminology- Single channel- Poisson arrivals and Exponential service times with infinite population.

**Dynamic Programming:** Introduction- Terminology, Bellman’s principle of optimality- Applications of Dynamic programming- shortest path problem- linear programming problem.

#### TEXT BOOK:

1. Operations Research/ J. K. Sharma4e./ MacMilan
2. Introduction to OR/ Hillier & Libemann/TMH

#### REFERENCE BOOKS:

1. Introduction to OR/Taha/PHI
2. Operations Research/NVS Raju/SMS Education/3rd Revised Edition
3. Operations Research /A. M. Natarajan, P.Balasubramaniam, A. Tamilarasi/Pearson Education.
4. Operations Research/ Wagner/ PHI Publications.
5. Operations Research/M.V. Durga Prasad, K.Vijaya Kumar Reddy, J. Suresh Kumar/Cengage Learning.

#### ME722OE: TOTAL QUALITY MANAGEMENT (Open Elective - II)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**UNIT - I**

Introduction, The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems.

Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

#### UNIT - II

**Customer Focus and Satisfaction**: Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships.

Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

#### UNIT - III

**Organizing for TQM**: The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, lshikawa diagram, paneto diagram, Kepner &Tregoe Methodology.

#### UNIT - IV

**The Cost of Quality**: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

#### UNIT - V

**ISO 9000:** Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q- 90. Series Standards, benefits of ISO 9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

#### TEXT BOOKS:

1. Total Quality Management / Joel E. Ross/Taylor and Francis Limited
2. Total Quality Management/P. N. Mukherjee/PHI

#### REFERENCE BOOKS:

1. Beyond TQM / Robert L. Flood.
2. Statistical Quality Control / E. L. Grant.
3. Total Quality Management: A Practical Approach/H. Lal.
4. Quality Management/Kanishka Bedi/Oxford University Press/2011.
5. Total Engineering Quality Management/Sunil Sharma/Macmillan.

#### ME723OE: MEASURING INSTRUMENTS (Open Elective - II)

**B.Tech. IV Year I Sem. L T P C**

#### 3 0 0 3

**Course Objectives:**

* To provide basic knowledge in transduction principles, sensors and transducer technologyand measurement systems.
* To provide better familiarity with the concepts of Sensors and Measurements.
* To provide the knowledge of various measurement methods of physical parameters like velocity, acceleration, force, pressure and viscosity.

**Course Outcomes:** After Completion of the course the student is able to

* Able to identify suitable sensors and transducers for real time applications.
* Able to translate theoretical concepts into working models.
* Able to understand the basic of measuring device and use them in relevant situation.

#### UNIT - I

Introduction to measurements. Physical measurement. Forms and methods of measurements. Measurement errors. Statistical analysis of measurement data. Probability of errors. Limiting errors.

Standards. Definition of standard units. International standards. Primary standards. Secondary standards. Working standards. Voltage standard. Resistance standard. Current standard. Capacitancestandard. Time and frequency standards.

#### UNIT - II

**Passive Sensors**

**Resistive Sensors:** Potentiometers, Strain Gages, Resistive Temperature Detectors (RTDs), Thermistors, Light-dependent Resistors (LDRs), Resistive Hygrometers, **Capacitive Sensors:** Variable capacitor, Differential capacitor, **Inductive Sensors:** Reluctance variation sensors, Eddy current sensors

#### UNIT - III

**Metrology:** Measurement of length – Plainness – Area – Diameter – Roughness – Angle – Comparators – Gauge Blocks. Optical Methods for length and distance measurements.

**Velocity and Acceleration Measurement:** Relative velocity – Translational and Rotational velocity measurements – Revolution counters and Timers - Magnetic and Photoelectric pulse counting stroboscopic methods. Accelerometers- different types, Gyroscopes-applications.

#### UNIT - IV

**Force and Pressure Measurement:** Gyroscopic Force Measurement – Vibrating wire Force transducer. Basics of Pressure measurement –Manometer types – Force-Balance and Vibrating Cylinder Transducers

* High- and Low-Pressure measurement

#### UNIT - V

**Flow, Density and Viscosity Measurements:** Flow Meters- Head type, Area type (Rota meter), electromagnetic type, Positive displacement type, Density measurements – Strain Gauge load cell method

* Buoyancy method.

Units of Viscosity, Two float viscorator –Industrial consistency meter

#### TEXT BOOKS:

1. Measurement Systems – Applications and Design – by Doeblin E.O., 4/e, McGraw Hill International, 1990.
2. Principles of Industrial Instrumentation – Patranabis D. TMH. End edition 1997

#### REFERENCE BOOKS:

1. Sensor Technology Hand Book – Jon Wilson, Newne 2004.
2. Instrument Transducers – An Introduction to their Performance and design – by Herman K.P. Neubrat, Oxford University Press.
3. Measurement system: Applications and Design – by E.O. Doeblin, McGraw Hill Publications.
4. Electronic Instrumentation by H.S. Kalsi.

#### ME831OE: PRINCIPLES OF ENTREPRENEURSHIP (Open Elective – III)

**B.Tech. IV Year II Sem. L T P C**

#### 3 0 0 3

**UNIT - I**

Introduction to Entrepreneurship: Definition of Entrepreneur Entrepreneurial Traits. Entrepreneur vs Manager, creating and starting the venture: sources of new ideas, method of generating ideas, creative problem solving – writing business plan, evaluating business plans. Launching formalities.

#### UNIT - II

Financing and Managing the new ventures: sources of capital, record keeping, recruitment, motivatingand leading teams, financial controls. Marketing and sales controls. E commerce and Entrepreneurship, internet advertising – new venture expansion strategies and issues.

#### UNIT - III

Industrial Financial Support: schemes and functions of directorate of industries, District industries centre (DICs) Industrial development corporation (IDC), State Financial corporation (SFCs), small scale industries development corporation (SSIDCs) Khadhi and village industries commission (KVIC) Technical Consultancy organisation (TCO), Small industries service institute (SISI), national small industries corporation (NSIC), small industries development bank of india (SIDBI).

#### UNIT - IV

Production and marketing management: Thrust areas of production management, selection of production techniques, plant utilisation and maintenance, designing the work place, inventory control, material handling and quality control. Marketing functions, market segmentation market research and channels of distribution, sales promotion and product pricing.

#### UNIT - V

Labour legislation, salient provision of health, safety, and welfare under Indian factories Act, Industrial dispute act, employees state insurance act, workmen’s compensation act and payment of bonus act .

#### TEXT BOOKS:

1. Robert Hisrich, & Michael Peters: Entrepreneurship, TMH, 2009.
2. Dollinger: Entrepreneurship, Pearson, 2009.

#### REFERENCE BOOKS:

1. Vasant Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, 2009.
2. Harvard Business Review on Entrepreneurship, HBR Paper Back.
3. Robert J. Calvin: Entrepreneurial Management, TMH, 2009.
4. Gurmeet Naroola: The entrepreneurial Connection, TMH, 2009.
5. Bolton & Thompson: Entrepreneurs—Talent, Temperament and Techniques, Butterworth Heinemann, 2009.
6. Agarwal: Indian Economy, Wishwa Prakashan 2009.
7. Dutt & Sundaram: Indian Economy, S. Chand, 2009.
8. B D Singh.: Industrial Relations & Labour Laws, Excel, 2009.
9. Aruna Kaulgud: Entrepreneurship Management by, Vikas publishing house, 2009.
10. Essential of entrepreneurship and small business management by Thomas W. Zimmerer & Norman M. Searborough, PHI-2009.
11. ND Kapoor: Industrial Law, Sultan Chand & Sons, 2009.

#### ME832OE: ENGINEERING MATERIALS (Open Elective – III)

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| --- | --- | --- | --- |
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P C** |
| **Course objectives:** | **3** | **0** | **0 3** |

* + To gain knowledge in applications properties strengtheningmechanisms in structural steels and super alloys and stainless steels
  + To develop a fundamental understanding of various electrical and electronic materials
  + To highlight the importance of bio materials.

**Course Outcomes**: At the end of the course, student will be able:

* + To select and design components based on their properties and requirements.
  + Awareness about the electrical and electronic materials
  + Knowledge about bio materials like, titanium and stainless steel based.

#### UNIT - I

Structural Steels: Introduction, Classification: HSLA steels, Dual phase steels, TRIP steels, Maragingsteels, HSS steels.

#### UNIT - II

Superalloys: Introduction, Classification, Applications and properties of Ni, Fe, Co based superalloysand their thermo-mechanical treatments.

#### UNIT - III

Electrical and Electronic Materials: Introduction, Classification, Applications and properties of Pyro, Piezo, Ferro-electrics, Extrinsic and Intrinsic semiconductors; super conducting materials.

#### UNIT - IV

Stainless steels: Ferritic, Martensitic, Austenitic stainless steels.

#### UNIT - V

Bio materials: Introduction, Property requirements for biomaterials, concept of biocompatibility, important bio metallic alloys**.**

#### TEXT BOOK:

1. Superalloys-II edited by C.T. SIMS, N.S. Stoloff and W.C. Hagel A Wiley-Inter science publication John Wiley and sons, New York, 1972.

#### REFERENCE BOOKS:

1. An Introduction to Materials Science and Engineering, W. D. Callister, John Wiley & Sons (2007).
2. Materials Science and Engineering, V. Raghavan, PHI, 2004.

#### ME833OE: LINEAR AND NON-LINEAR OPTIMIZATION TECHNIQUES (Open Elective - III)

**B.Tech. IV Year II Sem. L T P C**

#### 3 0 0 3

**UNIT - I**

**Linear Programming:** Introduction and need for optimization in engineering design, formulating linear programs, graphical solution of linear programs, special cases of linear programming.

#### UNIT - II

**The Simplex Method:** Converting a problem to standard form, the theory of the simplex method, the simplex algorithm, special situations in the simplex algorithm, obtaining initial feasible solution.

#### UNIT - III

**Duality and Sensitivity Analysis:** Sensitivity analysis, shadow prices, dual of a normal linear program, duality theorems, dual simplex method. Integer Programming: Formulating integer programming problems, the branch-and-bound algorithm for pure integer programs, the branch-and bound algorithmfor mixed integer programs.

#### UNIT - IV

**Non-linear Programming:** Introduction to non-linear programming (NLP), Convex and concave functions, NLP with one variable, Line search algorithms, Multivariable unconstrained problems, constrained problems, Lagrange Multiplier, The Karush-Kuhn-Tucker (KKT) conditions, the method of steepest ascent, convex combination method, penalty function, Quadratic programming,

#### UNIT - V

**Dynamic programming:** Evolutionary algorithms: Genetic Algorithm, concepts of multi objective optimization, Markov Process, Queuing Models.

#### TEXT BOOK:

1. S.S. Rao, Engineering Optimization: Theory and Practice, Wiley & Sons, New Jersey, 2009.

#### REFERENCE BOOKS:

1. F.H. Hiller and G.J. Liberman, Introduction to Operations Research, Tata-McGraw-Hill, 2010.
2. W.L. Winston, Operations Research: Applications and Algorithm, 4th Edition, Cengage Learning, 1994.
3. K. Deb, Optimization for Engineering Design, Prentice Hall, 2013.
4. M.C. Joshi and K. M. Moudgalay, Optimization: Theory and Practice, Narosa, 2004.