# BE (Mechanical Engineering)

## BE (ME) - I SEMESTER

### THORY

| CODE | TITLE | UNIT |
|------|-------|------|
| HU 1101 | Technical English | 1.0 |
| PH 1101 | Physics- I | 1.0 |
| CH 1201 | Engineering Chemistry | 1.0 |
| MA 1101 | Mathematics- I | 1.0 |
| ME 1101 | Engineering Mechanics | 1.0 |
| MA 1105 | Fundamental of Engineering Mathematics | 1.0 |

### SESSIONAL

| CODE | TITLE | UNIT |
|------|-------|------|
| ME 1102 | Engineering Graphics | 1.0 |
| CP 1202 | Unix & C Programming | 1.0 |
| PH 1102/ | Physics Lab./ | |
| CH 1202 | Chemistry Lab. | 0.5 |
| PE 1102 | Work Shop Practice- I | 0.5 |
| GA 1002 | NCC/ NSS/ PT & Games/ Creative Arts | 0.5 |

## BE (ME) - II SEMESTER

| CODE | TITLE | UNIT |
|------|-------|------|
| MA 2101 | Mathematics- II | 1.0 |
| EE 2101 | Basic Electrical Engineering | 1.0 |
| CP 2101 | Data Structure in C++ | 1.0 |
| CH 2103 | Environmental Science | 1.0 |
| PH 2103 | Physics- II | 1.0 |

| CODE | TITLE | UNIT |
|------|-------|------|
| ME 2102 | Computer Aided Drafting | 1.0 |
| CH 1202/ | Chemistry Lab./ | |
| PH 1102 | Physics Lab. | 0.5 |
| ME 2104/ | Engineering Mechanics Lab./ | |
| EE 3102 | Basic Electrical Engineering Lab. | 0.5 |
| CP 2102 | Data Structure Lab. | 0.5 |
| PE 2102 | Workshop Practice- II | 0.5 |
| GA 2002 | NCC/ NSS/ PT & Games/ Creative Arts | 0.5 |

## BE (ME) - III SEMESTER

| CODE | TITLE | UNIT |
|------|-------|------|
| EC3101 | Basic Electronics | 1.0 |
| MA3101 | Mathematics III | 1.0 |
| EE3101 | Introduction to System Theory | 1.0 |
| PE 3101 | Basic of Design & Manufacturing | 1.0 |
| ME 3103 | Automatic Control System | 1.0 |
| ME3206 | Thermal Engineering (Mech/Prod/Civil/Poly) | 1.0 |
| ME3207 | Principles of Mech. Engg. Sci. (EEE/ECE/Comp/IT) | 1.0 |

| CODE | TITLE | UNIT |
|------|-------|------|
| EC 3101 | Basic Electronics Lab. | 0.5 |
| EE3102 | Basic Electrical Engg. Lab. | 0.5 |
| PE 3102 | Design & Manufacturing Course Work | 0.5 |
| ME 3104 | Control System Lab. | 0.5 |
| GA3002 | NCC/NSS/PT & Games/ Creative Arts | 0.5 |

## BE (ME) - IV SEMESTER

| CODE | TITLE | UNIT |
|------|-------|------|
| MA4101 | Industrial statistics | 1.0 |
| PE 4203 | Metallurgy | 1.0 |
| ME4201 | Fluid Mechanics | 1.0 |
| ME4203 | Strength of Materials I | 1.0 |
| ME4205 | Engg. Measurements | 1.0 |
| ME4307 | Steam Power Systems(Mech) | 1.0 |
| ME4207 | Energy Engineering (Prod.) | |

| CODE | TITLE | UNIT |
|------|-------|------|
| ME4202 | Fluid Mechanics Lab. | 0.5 |
| ME4204 | Strength of Materials Lab. | 0.5 |
| ME4206 | Engg. Measurements Lab. | 0.5 |
| ME4208 | Energy Engg. Lab. | 0.5 |
| GA 4002 | NCC/NSS/PT & Games/CA | 0.5 |

## BE (ME) - V SEMESTER

| CODE | TITLE | UNIT |
|------|-------|------|
| MA5001 | Numerical Techniques in Engg. | 1.0 |
| PE 5205 | Manufacturing Processes I | 1.0 |
| ME5203 | Strength of Materials II | 1.0 |
| ME5301 | Fluid Machinery | 1.0 |
| ME5105 | Mechatronics | 1.0 |
| ME5107 | Refrigeration & Air Conditioning | 1.0 |

| CODE | TITLE | UNIT |
|------|-------|------|
| MA5002 | Numerical Techniques | 0.5 |
| PE 5206 | M.P. I Lab. | 0.5 |
| ME5106 | Mechatronics Lab. | 0.5 |
| ME5008 | Hydraulic Machine Lab. | 0.5 |

## BE (ME) - VI SEMESTER

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|---|---|---|---|---|---|---|
| MA6101 | Operations Research | 1.0 | PE6202 | M.P. II Lab. | 0.5 |
| PE6201 | Manufacturing Processes II | 1.0 | ME6202 | CADD Lab. | 0.5 |
| ME6201 | Computer Aided Design | 1.0 | ME6206 | Design of Machine Element Ses. | 0.5 |
| ME6203 | Theory of Machine I | 1.0 | ME6204 | Mechanical Engg. Lab. | 0.5 |
| ME6205 | Design of Mechine Elements | 1.0 | | | |
| ME6207 | I.C.Engines & Gas Turbines | 1.0 | | | |

## BE (ME) - VII SEMESTER

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|---|---|---|---|---|---|---|
| ME7101 | Production & Managerial Eco. | 1.0 | ME7208 | Mechanical Design Sessional | 0.5 |
| ME7203 | Heat & Mass Transfer | 1.0 | ME7104 | Project-I | 1.0 |
| ME7205 | Theory of Machine II | 1.0 | Elective-I | Course work | |
| ME7207 | Design of Mech. Systems | 1.0 | | (even no. of elective's theory) | 0.5 |
| ME 7209 | Power Plant Engineering | 1.0 | | | |
| | Elective I | 1.0 | | | |

## BE (ME) - VIII SEMESTER

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|---|---|---|---|---|---|---|
| ME8203 | Industrial Management | 1.0 | ME8204 | Thermal Engineering Lab. | 0.5 |
| ME 8205 | Non Conventional Energy | 1.0 | ME8106 | Project II | 1.0 |
| ME8207 | Industrial Pollution Control | 1.0 | ME8202 | Automobile Engg. Lab. | 0.5 |
| ME 8201 | Automobile Engineering | 1.0 | | | |
| ME 8209 | Robotics Engineering | 1.0 | | | |
| | Elective-II* | 1.0 | | | |

| HU 1101 | TECHNICAL ENGLISH | 1.0 |
|---------|-------------------|-----|

**MODULE – I**
Single word substitution, Idioms and phrases, Pairs of words, Common errors, Précis, Comprehension, Expansion.

**MODULE – II**
Official Correspondence - Memorandum, Notice, Agenda, Minutes, Circular letter, applying for a job, Resume, Demo-official letter.

**MODULE – III**
Business Correspondence-Types, sales letters; Social Correspondence- Invitation to speak, Congratulations; etc.

**MODULE – IV**
Report writing; general and technical report, Definition, Types, structure.

**MODULE – V**
Technical proposals, Definitions, types and format.

**MODULE – VI**
Research papers and articles.

**MODULE – VII**
Mechanics of manuscript preparation.

**BOOKS FOR REFERENCE:**
1. Blickle, Margaret D., and K.W.Houp.
2. Reports for Science and Industry, Henry Holt & Co. N.Y.
3. Duddy, E.A. & M.J. Freeman Written Communication in Business, Amercian book Co. N.Y.
4. Berry, Thomas Elliot, The most Common Mistakes in English Usage; Tata McGraw Hill.
5. Stevensin, B.W., J.R. Spicer and E.C. Ames, English in Business and Engineering. Prentice Hall, Eaglewood
6. Cliffs, N.J.
7. Raul, Asha, Effective Business Communication, Prentice Hall of India.
8. Singh B. Business Correspondence including Bank letters.
9. Singh B. Theory and Practice of Business Correspondence, HPJ Kapoor Publications.
10. Report Writing and Business Correspondence Mohan and Sharma, Tata McGraw Hill Publications, India.
11. Best, W.D. The Students companion, Rupa & Co. Publications.

## MODULE – I

Waves and Oscillations: ( SS* : Wave motion: longitudinal and transverse waves, plane waves, phase velocity). Wave packets and group velocity, wave equation, superposition of waves (RHK-Ch-18), equation of motion of simple harmonic oscillator and solutions, damped harmonic motion and forced oscillations(RHK 17.2-17.4,17.7,17.8)

[6]

## MODULE – II

**Fields:** Vector and scalar fields, physical and mathematical concepts of gradient, divergence and curl (Cartesian coordinates only), Gauss's theorem and Stokes' theorem (Statements only,
SAD-Ch.3).

[5]

## MODULE – III

**Electromagnetic Theory:** Gauss's law in integral and differential form, electric potential and relation with E(SAD 4.5-4.8),( SS*- capacitance(SAD-6.5) and electrostatic energy density (SAD 4.10)), dielectrics, three electric vectors, dielectric susceptibility boundary conditions on E and D(SAD 5.5-5.7, 5.9).

[5]

Amperes law in integral and differential form, applications.( SAD 7.1-7.4), Hall effect (RHK-32.4), three magnetic vectors (SAD 7.5), magnetic permeability and susceptibility, boundary conditions on B and H ( SAD 8.5-8.7).

[5]

Faraday's law in integral and differential form( SAD 9.2-9.3), ( SS - Inductance, magnetic energy density (SAD 8.8, 8.9)), continuity equation for charge (SAD 5.8), displacement current ( SAD 9.4), Maxwell's equations in free space (SAD 9.5), electromagnetic wave equation for plane waves in dielectric medium and free space, relation between $\vec{E}, \vec{B}$ and $\vec{k}$ , Poyinting vector (SAD 10.3-10.7).

[5]

## MODULE – IV

**Plasma Physics:** Plasma state, types of plasma, applications of plasma(FFC-Ch-1,2)

[4]

## MODULE – V

**Physical Optics:**
**Interference:** Two-Beam Interference( AG 12.1-12.6), interference in thin films and wedge-shaped layers(AG 13.8-13.9), reflection and anti-reflection coatings( AG 13.2-13.4), applications of interferometry: Newton's rings(AG 13.10), Michelson' Interferometer (AG 13.11)

[5]

**Diffraction**: Fraunhofer diffraction by single slit( AG 16.1-16.3) , double slit and grating ( AG 16.6-16.8), limit of resolution, Rayleigh criterion(AG 16.5), Fresnel diffraction(Qualitative, AG 17.1-17.3)

[5]

**Polarization : ( SS-** Polarization of light, Malus's law, polarization by reflection, Brewster's law, Double refraction)  Analysis of linearly and circularly polarized light( RHK 44.1-44.5), Fresnel's equations and their applications (AG  21.1-21.2)

[5]

**Text Books:**

1. Mathew N.O. Sadiku ( SAD), Elements of Electromagnetics, Oxford University Press
2. (2001)
3. A.Ghatak(AG), Optics, 3rd Edition, Tata Mcgraw Hill, 2005
4. Resnick, Halliday and Krane(RHK), Physics- Part-I & II, 5th Edition, John Wiley ( 2002)
5. F.F.Chen(FFC), Introduction to Plasma Physics, 2nd Edition, Plenum Press, 1994

**References:**

1. W.H.Hayt and J.A.Buck, Engineering Electromagnetics, Tata  McGraw Hill ( 2006)
2. M.R.Srinivasan, Physics for Engineers, New Age International, 1996
3. S.N.Sen, Introduction to Plasma Physics, Pragati Prakasan, Meerut -1, India

## MODULE – I

Chemical Bonding: Trends in periodic properties (ionization energy, electron affinity, electro negativity), VBT, VSEPR theory, MOT for diatomic molecules and polyatomic molecules, coordination complexes & ligands, CFT, colour and magnetism of coordination complexes, spectrochemical series

## MODULE –II

Kinetics and catalysis: kinetics of chain reactions, parallel reactions, side reactions, fast reactions in solutions, flash photolysis, kinetics of catalytic action (acid base catalysis, biological catalysis), application of catalyst in industrially important processes (Haber's processes, Ostwald process, Bergius process)

## MODULE – III

Thermo-chemistry and Fuels: Hess's law, entropy, enthalpy and combustion calculations, characterization and application of fossil fuels, solid fuel (carbonization & gassification), liquid fuels (refining, reforming, petrol & diesel, knocking characteristics, octane and cetane number) and gaseous fuels (water gas, producer gas, coal gas and biogas), lubricants and its properties

## MODULE –IV

Electrochemistry and corrosion sciences: Redox process cell, potential and free energy, galvanic cells, electrolysis and Nernst's equation, Fuel cells, and its applications, chemical and electrochemical corrosion, general methods of corrosion prevention (with brief introduction to chemistry of paints, varnishes and enamel)

## MODULE –V

Fundamentals of spectroscopic techniques: Basic principles of vibrational, rotational and Mossbauer spectroscopy

## MODULE – VI & VII

Macromolecules: Classification, Addition and Condensation polymers, molecular weight of polymers ($M_n$, $M_w$, $M_v$), glass transition temperature ($T_g$), structure property relationship in polymers (chemical, electrical, optical and mechanical), examples and use of inorganic polymers, synthesis of some commercially important polymers and their use (Nylon 6, Nylon 6, 6, PE, PET, PS)

## MODULE – VI & VII

An introduction to computational chemistry

### Text Book:
1. Applied chemistry A text book for engineers and technologists, H. D. Gesser, Plenum publishers.
2. Inorganic chemistry: J. D. Lee.
3. Engineering chemistry: Sashi Chawla

### Reference:
1. Fundamentals of molecular spectroscopy: C. N. Banwell, TMH publication
2. Computational chemistry: E. Lewars, Kluwer publication
3. Physical chemistry: P. W. Atkins

### Analytical Trigonometry:

De-Moivre's Theorem and its applications. Expansion of Sinx and Cosx in powers of x. Complex arguments. Separation into real and imaginary parts Gregory's Result. Expansions. Summation of trigonometric Series. Hyperbolic functions.

(8L)

### Differential Calculus:

Successive Differentiation. Leibnitz's Theorem. Rolle's Theorem. Lagrange's and Cauchy's Mean value Theorem. Generatalised Mean value Theorem. Taylor's and Maclaurin's infinite series. Cartesion and polar subtangenent and Subnormal. Pedal equations. Orthogonal intersection of curves. Curvature and radius of Curvature in case of Cartesian parametric, polar, pedal and trangential polar forms. Centre of curvature and evolute. Indeterminate forms L Hospital's Rule. Concavity, convexity and points of inflexion. Asymptotes (cartesian Co-ordinates only).

Functions of two variables. Partial derivatives. Euler's Theorem on Homogeneous functions. Its generalisation and extension. Total differential and derivatives. Errors and Approximations. Taylor's series in case of two variables. Maxima and Minima of two variables. Lagrange's method of Undertermined multipliers in case of two and three variables. Jacobians. Envelope of curves. Tangent planes and Normal lines.

(22L)

### Integral Calculus:

Reduction Formula. Beta and gamma functions. Area, length, volume and surface area without the use of multiple integrals.

(9L)

### Infinite series:

Convergency and Divergency of infinite series. Tests for Convergence. Comparison Test, p series test, Cauchy's root test. D' Alembert's ratio test, Razabe's Test, Gauss's Test, Logarithmic and Higher logarithmic ratio test (No proof). Leibnitz's Rule for alternating series test.

(6L)

### Books Recommended:

1. Higher Trigonometry. Das and Mukherjee (U.N. Dhur & Co.)
2. Differential Calculus. Pran Nath and Agarwal. Tara Publications, Varanasi
3. Integral Calculus. Das and Mukherjee (U.N. Dhur & Co.)
4. Engineering Mathematics. H.K. Dass
5. Higher Engineering Mathematics B.S. Grewal (Khanna Publishers)

**Equivalent Force System and Equilibrium:** Principles of statics, laws of mechanics, freebody diagram, coplanar, non-coplanar and spatial force system and conditions of equilibrium, vector representation and analysis of forces and moments, Varignon's theorem.

**Structural Mechanics:** Analysis of simple plane truss by method of sections and methods of joints, analysis of frames and parabolic cables, cantilever and simply supported beams with concentrated, distributed and moment loads, shear force and bending moment diagrams, concept of stress and strain.

**Interfacial Friction:** Friction and impending motion, static, kinetic and rolling friction, application to inclined planes, wedges, screws jacks and belts.

**Kinematics and Kinetics of Particle and Rigid Bodies:** Conceptual framework and vector representation of displacement, velocity, acceleration, linear and angular momentum, rectilinear and curvilinear motion in two dimensions, centroidal and non-centroidal rotation, general plane motion, Newton's laws of motion, D'Alembert's principle, equilibrium of dynamic forces.

**Work and Energy:** Translation and rotation of rigid body about a fixed axis, conservation of energy, energy and work equations in translation and rotational motion, virtual work.

**Impulse and Momentum:** Impulse force and momentum, conservation of momentum, coefficient of restitution, momentum equation. Vibrating Systems: Inertia, features of a vibrating system, free vibration, systems with single degree of freedom.

**Books Recommended:**

1. Kumar, Engineering Mechanics
2. Shames, Engineering Mechanics

| | | |
|---|---|---|
| **MA 2101** | **MATHEMATICS- II** | **1.0** |

### Integral Calculus:
Operations under the sign of integration, Multiple integrals, change of order of integration, Transformation of Co-ordinates, Area, Volume and Surface area of solids using multiple integrals.

(8L)

### Ordinary Differential Equations:
Linear differential equations: Bernoulli's from Exact equations, Nonlinear equations, Clairaut's form, Higher order equations with constant coefficients. Cauchy's and Legendre's differential equations. Solution of higher order equation by the change of independent variable, Method of variation of Parameters in Simple cases,

Applications to Engieering problems.

Series solution of Differential equations by the method of Frobenius.(Roots differing by non integer and equal roots).

(14L)

### Algebra of Matrices:
Rank of a matrix. Consistency and inconsistency of a system of linear equations. Eigen values and eigen vectors. Cayley Hamiliton Theorem.

(3L)

### Vector spaces:
Definition, examples and some simple properties. Subspaces, linear combination, linear dependence and independence, Basis and dimension. Norm of a vector, Inner Product. Cauchy-schwartz inequality, orthogonal sets. Gram-schmidt process of construction of orthogonal sets. Parallelogram law and Pythagorian theorem.

(8L)

### Vector Calculus and Tensor Analysis:
Differentiation of vectors, Radial and transverse, tangential and normal acceleration of a particle moving on a plane curve. Directional derivatives, Gradient, Divergence and Curl. Expansion Identities. Vector integration. Conservative system of forces. Solenoidal and Irrotational vectors. Theorems of Green, Stoke and Gauss and their applications,

Tensors, transformation of Co-ordinates, contravariant and covariant vectors and Tensors. Rank of a tensor. Addition and multiplication of tensors. Mixed tensors Contraction.

(10L)

### Books Recommended:

1. Advanced Engineering Mathematics byE. Kreyszig
2. Advanced Mathematics for Engineers By Chandrika Prasad (Prasad Mudranalaya)
3. Advanced Engineering Mathematics By H.K. Das.

### MODULE – I

**Introduction**: Importance of Electrical Engineering in day-to-day life. Electrical elements and their classification. KCL and KVL equations. Loop current and Node voltage method. D.C. Circuits: Steady state analysis with independent and dependent sources; Series and Parallel circuits; Star-Delta conversion. D.C. Circuit Theorems: Superposition theorem; Thevenin's & Norton's theorem; Maximum Power Transfer theorem.

(12)

### MODULE – II

**A.C. Single-phase Series Circuits**: Common signals and their waveforms. RMS and Average value. Form factor & Peak factor of sinusoidal waveform. Impedance of Series circuits. Phasor diagram. Power. Power factor. Power triangle.

(5)

### MODULE – III

**A.C. Single-phase Parallel Circuits**: Admittance method, Phasor diagram. Power. Power factor. Power triangle.

(5)

### MODULE – IV

**Resonance and Q-factor, A.C. Circuit Theorems**: Superposition theorem; Thevenin's & Norton's theorem; Maximum Power Transfer theorem.

(7)

### MODULE – V

**Three Phase Circuits**: Line and Phase relation for Star and Delta connection. Power relations. Analysis of balanced and unbalanced 3 phase circuits.

(7)

### MODULE – VI

**Magnetic Circuits**: Introduction. Series-parallel magnetic circuits. Analysis of Linear and Non-linear magnetic circuits. Energy storage. A.C. excitation. Eddy currents and Hysteresis losses.

(5)

### MODULE – VII

Coupled Circuits (Dot rule), Self and mutual inductances, Coefficient of coupling.
**Basic Indicating Instruments**: Moving coil and moving iron type instruments.

(4)

**Books Recommended:**

1.      Nagrath and Grabel, Basic Electrical Engineering
2.      Fitzzerald and Higinbotham, Basic Electrical Engineering

## MODULE – I & II

**Introduction to C++ and algorithm analysis:** C++ classes, C++ details, Using matrics, Mathematical background for algorithm analysis, model and what to analyze, Running Time calculations.

## MODULE – III

**Lists, Stacks and Queues**: Abstract Data Types, The list ADT, The Stack ADT, The Queue ADT

## MODULE – IV

**Trees**: Preliminaries, Binary Trees, The Search Tree ADT – Binary Search Trees, AVL Trees, Splay Trees, Tree Traversals, B-Trees.

## MODULE – V

**Hashing and Priority Queues:** Model and Simple implementations, Binary Heap, Applications of Priority Queues, d-Heaps, Leftist and Skew Heaps.

## MODULE – VI

**Sorting:** Preliminaries, Insertion sort, A Lower Bound for Simple Sorting Algorithms, Shell sort, Heap sort, Merge sort, and Quick short.

## MODULE – VII

**Graph Algorithms:** Definitions, Topological Sort, Shortest Path Algorithms, Network Flow Problems and Minimum Spanning Tree.

**Text Books:**
1. Mark A. Weiss – Data Structures & Algorithm Analysis in C++, 2nd Edition, Pearson Education, New Delhi – 2002.

**Reference:**
1. Gregory L. Heilean – Data Structures Algorithms, and Object Programming, Tata McGrow Hill, New Delhi – 2002.
2. Adam Drozdek – Data Structures and Algorithms in C++, Thomson Learning (Vikas Publishing House) New Delhi – 2001.
3. John R. Hubbard – Data Structures with C++, Tata McGraw Hill, New Delhi, 2004

## MODULE– I
**Environmental Awareness**: Multidisciplinary nature of environmental Science, Definition, scope , importance and need for public awareness

(2)

## MODULE– II
**Ecology and Environment:** concept of an ecosystem ,structure and function of an ecosystem, producer ,consumer and decomposer, energy and nutrient flow biogeochemical cycles, food chain ,food web, ecological pyramid

(3)

## MODULE– III
**Environmental Pollution:** Segments of environment,  sources, pathways and fate of environmental pollutants, causes of environmental pollution , physical ,chemical and biological transformation of pollutants   , population explosion, environment and human health, human rights, value education ,women and child  welfare

(5)

## MODULE– IV
**Air Pollution**: various segments of atmosphere and  their significance,classification of air pollutants, toxic effects, sampling and analysis, stationary and mobile emission, sources and their control, photochemical smog ,sulphurous smog, green house effect, global warming, ozone depletion, Air (prevention and control of pollution ) Act

(10)

## MODULE– V
**Water Pollution:** Water resources ,sources of water pollution ,various pollutants, their toxic effect, potability of water , municipal water supply , disinfection, characteristics of waste water, primary and secondary waste water treatment, BOD and COD measurement and their significance ,rain water harvesting ,water shed management,Water ( pollution and control ) Act.

(12)

## MODULE– VI
**Natural Resources and Biodiversity**: Renewable and non renewable resources, Forest resource, consequences of deforestation, floods and draughts, equitable use of resources for sustainable development, Dams benefits and problems, Biodiversity: ecosystem diversity , threats to biodiversity, conservation of biodiversity**.**

(4)

## MODULE– VII
A brief introduction to Noise  Pollution, Soil Pollution, Solid Waste Management.

(4)

**Books Recommended:**
1.      Sharma and Kaur, Environmental Pollution
2.      De, Environment Chemistry

## MODULE – I
## Special Theory Of Relativity

Postulates, Galilean transformations, Lorentz transformations, length contraction, time dilation, velocity addition, mass change and Einstein's mass energy relation. (AB: 1.1,1.2,1.4,1.7,1.8,1.9, and Appendix to chapter-1

[6]

## MODULE – II
## Quantum Mechanics:

Planck's theory of black-body radiation (AB: 2.2, 9.5, 9.6), Compton effect (AB: 2.7), wave particle duality, De Broglie waves, Davisson and Germer's experiment(AB:2.4, 3.1, 3.2, 3.3, 3.4, 3.5), uncertainty principle(AB:3.7,3.8,3.9), physical interpretation of wave function and its normalization(AB:3.2), expectation value(AB:5.4).

[8]

Schrodinger equation in one dimension(AB:5.2), solutions of time-independent Schrodinger equation for free particle(AB:3.6, 5.5, 5.6), particle in an infinite square well, potential barrier and tunneling(AB:5.7, 5.8), hydrogen atom (qualitative)(HRW:40-8).

[8]

## MODULE – III
## Statistical Physics  And Thermodynamics:
Elementary ideas, comparison of Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics (AB: 9.1, 9.2, 9.3, 9.4).

[4]

Zeroth law, first law, second law, entropy, heat transfer, steady state one-dimensional heat conduction [(HRW:19-2, 19-9, 21-3, 19-11),(SS:14.2, 14.7)].

[6]

## MODULE – IV
## Lasers And Applications:

Emission of light by atoms, spontaneous and stimulated emission (AB: 4.9, and AG: 23.1), Einstein's A and B coefficients, laser: population-inversion (AG: 23.4), properties of laser radiation, Ruby & He-Ne lasers, applications of lasers (AB: 4.9) and AG: 23.1), elementary ideas of holography (AG: 18.1) and fiber optics (AG: 24.1-24.3).

[8]

## MODULE – IV
## Nuclear Physics:
Nuclear forces, binding energy, liquid drop model (AB: 11.1-11.6), fission, nuclear reactors, fusion, energy processes in stars, controlled thermonuclear reactions (AB: 12.9-12.12).

[5]

## Text Books:

1.      Arthur Beiser, Concepts of Modern Physics, 5th edition, Tata McGraw Hill, 1997.
2.      Ajoy Ghatak, Optics, 2nd edition, Tata McGraw Hill, 1997.

## Reference Books:

1.      Jasprit Singh, Modern Physics for Engineers, John Wiley & Sons, 1999.
2.      Kenneth Krane, Modern Physics, 2nd edition, John Wiley & Sons, 1998.
3.      Wehr, Richards and Adair, Physics of the Atom, 4th edition, Addison Wesley.

| EC 3101 | BASIC ELECTRONICS | 1.0 |
|---------|-------------------|-----|

### MODULE – I

Introduction to PN junction diodes, Characteristics of semiconductor diodes, Analysis of simple diode circuits: DC and AC load lines, Zener diode, Characteristics and applications in regulators.

(4)

**Text Book:**
1. "Integrated Electronics"  Millman & Halkias, McGraw Hill.

### MODULE – II

**Application of diodes, Rectifiers:** Half wave rectifier, Full wave rectifier with π filter.
**Clipping and clamping circuits:** Elementary diode clippers, Transfer function characteristic, Clipping at two independent levels using diodes and Zener diodes, Operation of an elementary clamping circuit.

(6)

**Text Book:**
1. "Electronics Devices & Circuits"  Millman & Halkias, McGraw Hill.

### MODULE – III

**Fundamentals of transistors:** Introduction to transistor circuits for CB, CE, CC configurations. Transistor biasing and bias stability. JFET & MOSFET, characteristics, biasing and small signal low frequency analysis of CD, CS configurations, FET as VVR,

(6)

**Text Book:**
1. "Electronics Devices & Circuits"  Millman & Halkias, McGraw Hill.
2. "Integrated Electronics" Millman & Halkias, McGraw Hill.

### MODULE – IV

Small signal low frequency analysis of CE, CB and CC amplifiers.

(6)

**Text Book:**
1. "Integrated Electronics" Millman & Halkias, McGraw Hill.

### MODULE – V

**Transistor Power Amplifiers:** Circuits and Operations of Class A, Class B, Class C and Push-Pull Configurations.

(6)

**Text Book:**
1. "Electronics Devices & Circuits" Millman & Halkias, McGraw Hill.

### MODULE – VI

Logic circuit implementation of Boolean expressions, Adder, Subtracter, Seven-segment Display, Basic concept of TTL & CMOS logic system, Flip-flops.

(5)

**Text Book:**
1. Electronics Fundamentals and Applications", D. Chattopadhay & P. C. Rakshit, New Age International, 5/E

## MODULE – VII

**Operational amplifiers and its applications:** Characteristics, Parameters, Measurements, Emitter Coupled Differential Amplifier, Transfer Characteristics, Voltage gain, Input and Output impedance of Inverting and Non-inverting amplifiers using OP-AMP, Linear and Non-linear applications of OP-AMP: Voltage follower, Phase inverter, Scale changer, Integrator, Differentiator.

(12)

**Text Book:**
1. "Integrated Electronics" Millman & Halkias, McGraw Hill.

**Reference Books:**
1. "Microelectronic Circuits", Sedar and Smith.
2. "Operational Amplifiers and Linear Integrated Circuits" by R. A. Gayakwad, PHI.
3. "Electronic Devices and Circuit Theory", Nashelesky & Boylestead, PHI.
4. "Linear Integrated Circuit", S. Jain & D. Roychoudhury, New Age International.
5. "Electronics Fundamentals and Applications", D. Chattopadhay & P. C. Rakshit, New Age International.
6. "Electronic Devices and Circuits", Allan Mottershed, PHI.

| MA3101 | Mathematics III | 1.0 |

## Special Functions:

Bessel's equation: solution and Bessel's function of the first kind, Recurrence relations. Orthogonality of Bessel's Functions. Generating function and Bessel's integral. Legendre's equation: solution and Legendre's polynomials, Rodrigue's Formula. Orthogonarity relations. Generating function and recurrence relation. Definition of Hankekl's function. Elliptic Integral of the first and second kind. Jacobi's form of elliptic integrals.

(8L)

## Complex Variables:

Continuity, differentiability and analyticity of a function of a complex variable, Cauchy Riemann differential equations in Cartesian and polar forms. Harmonic functions, Bilinear and conformal transformations. Complex integration, Cauchy's integral theorem and formula. Derivatives. Taylor's and Laurent's Series. Poles and Singularities. Cauchy's Residue Theorem. Contour integration (Poles on real axis excluded)

(13L)

## Partial differential equations:

Formation of partial differential equations. Lagrange's first order linear equations. Non linear equations. Higher order differential equations with constant Co-efficients. Non homogeneous equations: solution by separation of variables. Boundary value Problems. wave equation in one dimension and its solution. Derivation of one dimensional heat equation and its solution.

(10L)

## Fourier Series and Fourier Transform:

Periodic functions Existence conditions Euler's formulae. Half range series. Fourier series of functions with arbitrary period.
Fourier Integral Formula, Fourier Transform, Inversion Theorem, Fourier sine and cosine transforms and inversion formulae, Linearity property, Convolution or Faltung theorem. Relationship between Fourier and Laplace transform. Finite Fourier Transforms. Heaviside, Unit step function and Dirac Delta Function

(10L)

## Statistics:

Mean and variance. Moments. Concept of Random variable. Probability density and Distribution functions Problems, Elements of error analysis

(4L)

## Books Recommended:

1.     Engineering Mathematics – E. Kreyszig
2.     Advanced Engineering Mathematics – C. Prasad
3.     Fourier Transforms – I.N. Sneddon

16

## MODULE – I
**Introduction to signals and systems:** Definition, Basis of classification, Representation of common signals and their properties, System modeling

(4)

## MODULE – II
**Analogous System:** Introduction, D Alembert's Principle, Force-voltage and force-current analogies, Electrical analogue of mechanical, Hydraulic and thermal systems.

(5)

## MODULE – III
**Fourier Transform Method:** Introduction, Fourier transform pair, Amplitude spectrum and phase spectrum of signals, Sinusoidal transfer function.

(3)

## MODULE – IV
**Laplace Transform Method:** Introduction, Laplace transform pair, Laplace transformation of common functions, Gate function, Step function and impulse function, Laplace theorems shifting, initial value, final value and convolution theorems.
Inverse Laplace transform by partial fraction expansion and convolution integral method.

(12)

## MODULE – V
**System Analysis:** System Analysis by Laplace Transform method, System response. Natural, forced, transient and steady state responses. Transfer function and characteristic equation, Superposition integral, Concept of poles and zeros, Nature of system response from poles and zeros.

(6)

## MODULE – VI
**System Stability:** Concept of stability, Types, Necessary and sufficient conditions, Routh Hurwitz stability criterion, Limitations and its applications to closed loop systems.

(4)

## MODULE – VII
**State-Space Concept:** Introduction, Definition: State, State variable, State vector and state space, State space representation, Derivation of State model from transfer function, Bush form and diagonal canonical form of state model, Non-uniqueness of state model, Derivation of transfer function from state model, Transition matrix and its properties, Solution of time invariant state equation.

(6)

**Text Books:**
1. Analysis of Linear Systems – D.K.Cheng.
2. Control System Engineering – Nagrath & Gopal
3. Control System – A. Anand Kumar

**Reference Books:**
1. Networks and Systems – D. Roy Choudhury
2. Signals and Systems - Basu & Natarajan

- Basic concept of engineering design and requirements of design, competitiveness and design techniques, System approach for design, Hi technology and society.

  (5 Lectures)

- Identification and analysis of needs, Ideonomics in engineering design, creativity, innovations and patent laws.

  (5 Lectures)

- Principal and elements of visual design, model making, appearance and aesthetics.

  (5 Lectures)

- Selection of materials, industrial manufacturing with metals and plastics.

  (5 Lectures)

- Design for manufacturability, assembly, maintainability and safety, product specifications.

  (5 Lectures)

- Product, people and environment, Human factor in designing, Waste minimization through designing

  (5 Lectures)

- Concept of reverse engineering and concurrent engineering, Market research, consultant and outside services, Report preparation and presentation.

  (10 Lectures)

**Text Books:**

1. Design and Manufacturing, An Integrated Approach, S. Kumar and Goutam Sutradhar, Oxford and IBH Publications Co. Pvt. Ltd., New Delhi.

**MODULE - I**
Concept of Automation and control system. Open loop/closed loop control system, Use of Laplace transformation in control system. Transfer function concept, Block Diagram and bearings.

(8 Lectures)

**MODULE - II**
**Mechanical Actuation System:** Cams, Gears, Kinematic chains, belt and chain drive.

(4 Lectures)

**MODULE - III**
**Modeling of Control System**: Description of Mechanial systems, Fluid systems and Thermal systems.

(5 Lectures)

**MODULE - IV**
**Microprocessor:** Introduction to 8051 Microcontroller & embedded systems 8085 Intel Microprocessor details, Micro computer structure application.

(10 Lectures)

**MODULE - V**
**Programmable Logic Controller:** Design and structure, Latching, sequencing Logic functions.

(6 Lectures)

**MODULE - VI**
**Hydraulic and Pneumatic system:** Actuation systems, control valves, cylinder operation.

(6 Lectures)

**MODULE – VII**
Applications of Control System in Automation of Manufacturing systems. Case studies and examples applicable to Domestic Appliances, Automobile and other Industries.

(6 Lectures)

**Text Books:**

1. Mechatronics by W.Bolton, Pearson Education.

**Reference Book:**

1. Linear Control System by Prof. B.S. Manke, Khanna Publication.
2. The 8051 Micro Controller and Embedded Systems by M.A. Hazidi, J.G. Mazidi, R.D.McKinlay.

**MODULE - I**

Definitions and Elementary concepts of Thermodynamics, Zeroth law of Thermodynamics and its significance. Concept of heat and worr and Properties of Ideal gas.

(8 Lectures)

**MODULE- II**

First law of Thermodynamics and its applications to non-flow and steady flow systems.

(6 Lectures)

**MODULE- III**

Second law of Thermodynamics, Concepts of heat engines, refrigerator and heat pump. Concept of Entropy, Entropy changes for various reversible processes.

(6 Lectures)

**MODULE - IV**

Cycles – Carnot cycle, Otto cycle, Diesel cycle, Joule/Brayton cycle, Rankine cycle. Vapour compression refrigeration cycle and its C.O.P.

(4 Lectures)

**MODULE - V**

Principle of I.C. engines, Two-stroke and four stroke cycle engines, indicated and brake power.

(4 Lectures)

**MODULE - VI**

Principles of steam Turbine, Impulse and Reaction turbines, Velocity diagrams.

(5 Lectures)

**MODULE - VII**

Heat transfer, one dimensional steady state conduction. Application to composite walls and cylinders, Critical thickness of insulation, Forced and free convection. Radiation heat transfer.

(8 Lectures)

**References:**

1. An Introduction to Thermodynamics – P.K. Nag
2. Engineering Thermodynamics – R.K.Rajput
3. Thermal Engineering – P.L. Ballaney
4. Thermal Engineering – R.K. Rajput
5. Thermal Engineering – A.S. Sarao

| ME3207 | PRINCIPLES OF MECH. ENGG. SCI. | 1.0 |

## MODULE – I
Thermodynamic System, control volume, intensive and extensive properties. Zeroth Law of Thermodynamics, Concept of temperature, Heat and work. Thermodynamic properties of pure substances. Thermodynamic property table and charts.

(5 Lectures)

## MODULE – II
First law of Thermodynamics, Energy and its forms. Enthalpy, specific heats. First law applied to flow Non-flow and steady processes.

(4 Lectures)

Second law of Thermodynamics, Kelvin-Plank and Clausius Statements, reversible and irreversible process, Thermodynamic (absolute) temperature scale.

(4 Lectures)

## MODULE –III
Entropy: Inequality of Clausius and concept of Entropy. Entropy change of a system and control volume. Carnot cycle, Otto cycle, Diesel cycle.

(6 Lectures)

## MODULE –IV
Classification and brief description of Low and High Pressure boilers; mountings and accessories; draught and performance of boilers.

(5 Lectures)

## MODULE – V
Basic concepts of Conduction, convection and Radiation; one dimensional steady state conduction. Application to composite walls and cylinders, Critical thickness of insulation.

(7 Lectures)

## MODULE – VI
Simple stresses and strains, Bending moment and shear force diagrams graphical representation of stress and strains, strain rosettes.

(5 Lectures)

## MODULE- VII
Linear single degree of freedom system, free system with damping  Balancing of revolving masses in a plane and in different planes.

(9 Lectures)


**Books:**
1. Fundamentals of Classical Thermodynamics – G.J. Van Wylen and R.E. Sorntag, Second Edition, Wiley Eastern (1984).
2. An Introduction to Thermodynamics – P.K. Nag
3. Thermal Engineering – R.K. Rajput
4. Strength of Materials – F.L. Singer
5. Theory of Machines – Thomas Beven

**FOURTH SEMESTER**

| MA4101 | INDUSTRIAL STATISTICS | 1.0 |
|--------|----------------------|-----|

Methods of least squares, Linear and parabolic trends, Bivariate distribution, Correlation, Rank correlation, Linear regression, Sample space, Random experiments and randjom variables, Concept of probability, Conditional probnability, Addition and multiplication laws Baya's theorem . Probability distributjion: Binomial, Poison and Normal Distributions, Concept of geometric hypergeometric and exponential distributions, their properties and applicaktions to industrial problems.

Central limit theorem, Simple sampling and sampling of variables, Sample tests, Tests of significance, Chi-square test, Student 't' test. 'F' test and their properties and applications.

Analysis of variance: Analysis of variance of one and two criterion of classifications, Design of experiments, Basic principle of experimental design, Latin squares, Randomised block design, Concept of control charts and its applications in process control.

**Suggested Books:**

1.      Erwin Miller and John E. Freund – Probability and Statistics for Engineers
2.      Sharma and Goyal – Mathematical statistics.

Review of Engineering and industrial materials – their classification and application, recent development in metallic materials

A brief description of iron and steel making – Raw materials Principles and processes

Isomorphous, eutectic and peritectic systems, Iron – Carbon equilibrium diagram, classification of steels, effect of alloying elements on steels. Tool steels

Isothermal decomposition of austenite (TTT Curve), transformation of austenite upon continuous cooling, annealing, normalising, hardening, tempering, hardenability of steel, Jominey hardening test, end quench test, surface hardening, case hardening, recovery, recrystallisation and grain growth

Grey iron, S.G. Iron, white iron, malleable iron. Principles of corrosion, forms of corrosion, factors affecting the rate of corrosion, corrosive agents, protection against corrosion; weld metal zone, HAZ, parent metal zone, Joint efficiency, weldability, concepts of ductile and brittle fractures

Properties and applications of Non ferrous Metals and Alloys-Al & Cu

**Text Books:**

1.  Elements of Metallurgy          D. Swaroop
2.  Materail Science and Engineering     V. Raghvan
3.  Metallurgy for Engineers          L.C.Rollagon

## MODULE – I
**Concept of continuum and physical properties of fluids**: like density, viscosity etc. Fluid Statics: Concept of pressure, equation of equilibrium, Forces on plane and curved surfaces, buoyancy and stability of floating bodies.

(7 Lectures)

## MODULE – II
**Kinematics of fluid flow:** Eulerian and Lagrangian description of fluid flow, material derivative and acceleration, streamlines, Pathlines. Motion of fluid element: translation, rotation and vorticity, Concept of stress and stress tensor, deformation and strain rate tensor stress and strain rate relationship for Newtonian and non-Newtonian fluids.

(7 Lectures)

## MODULE – III
**Control volume analysis:** Transport theorem, conservation laws of mass, momentum and energy. Ideal fluids, Continuity and Euler's equations, Bernoulli's equation and its applications. Two dimensional flow of ideal fluid: Stream function, velocity potential, simple flow, Uniform flow, sources and sinks, doublet.

(7 Lectures)

## MODULE – IV
**Viscous flows:** Couette Flow, Hugen Poiseuille flow, concept of boundary layer, boundary layer on a flat plate. Dimensional analysis and similitude, Buckhingham's theorem.

(7 Lectures)

## MODULE – V
**Internal flows:** Friction factor, Darcy-Weisbach friction factor, Moody's diagram. Boundary Layer theory, Boundary layer equation, Laminar and turbulent boundary layer and its growth over flat plate. Momentum boundary layer and its solutions, separation of boundary layer and its control.

(5 Lectures)

## MODULE – VI
**Compressible fluid flow:** Introductory concepts, continuity momentum and energy equations. Sonic velocity, propagation of elastic waves due to compression of fluid, propagation of elastic waves due to disturbance in fluid, Stagnation properties. Isentropic flow: effect of area variation on flow properties, isentropic flow through nozzles, diffusers ejectors. Normal shock: property relations, performance of C.D. Nozzles.

(6 Lectures)

## MODULE – VII
**Introduction to C.F.D and softwares:** Concept of C.F.D, Modeling and simutation of incompressible fluid flow problems through software, its one dimensional & two dimensional analysis of linear and non linear type of problems.

(6 Lectures)

**Text Book:**
1.	Hydraulics and Fluid Mechanics by Modi and Seth, 12th ed. 1998, Standard Book House, Delhi .

     Or
2.	Fluid Mechanics and Hydraulic machines by R.K. Bansal, 8th ed. 2002, Laxmi Publication (P) Ltd.

**Reference Books**:
1.	Fluid Mechanics and Machinery by D. Rama, Durgaiah. New Age International Pvt. Ltd.
2.	Fluid Mechanics with engg.  Application, by J.B. Franzini & Finnemore, 9th ed. 1997 Mc Graw Hill.
3.	Foundations of Fluid Mechanics by S.W. Yuan, 1998, PHI (P) Ltd. New Delhi.
4.	Fluid Mechanics by V.L. Streeter & E.B. Wylie, 1st SI metric ed. 1981, Mc Graw Hill Book Company.
5.	Introduction to compressible flow by S.M. Yahya.

**MODULE - I**

Two dimensional state of stress at a point. Complementary shears, Principal stresses Graphical representation of state of stress.

(6 Lectures)

**MODULE - II**

Two dimensional state of strain at a point, Principal strains, Graphical representation state of strain, Strain rosettes.

(6 Lectures)

**MODULE - III**

Distribution of bending stress and shear stress in the cross-section of beams.

(6 Lectures)

**MODULE - IV**

Differential equation of the elastic curve-Deflection of beams by double integration method – Area moment theorems – Application to simply supported, Cantilever and overhanging beams.

(8 Lectures)

**MODULE - V**

Statically indeterminate beams: propped cantilevers, built in beam, fixed beams and continuous beams. Short and long columns.

(7 Lectures)

**MODULE - VI**

Strain energy for axial load, bending and torsion. Castigliano's theorem – Application. Deflection due to shear.

(6 Lectures)

**MODULE - VII**

Torsion of circular shaft and power transmitted by the shaft. Combined bending and torsion of circular shaft – Equivalent B.M. and Equivalent Twisting moment.

(6 Lectures)

**Recommended Books:**
1.      Strength of Materials – Singer, F.L. Harper & Row 1962.
2.      Elements of Strength of Materials, S.timoshenko, Nannostrand, 1970.
3.      Strength of Materials, Ryder Mac Mllan, 1963.

## MODULE - I

Generalized Measurement Systems: Introduction, Description of Stages in Measurements, Calibration, Accuracy, Precision and Error, Error Classification, Treatment of Test data, uncertainty Analysis.

(7 Lectures)

## MODULE - II

Instrument selection and their Classifications: comparative Analysis of various types, Principle of operation, Uses, Advantages and limitations of each type.

(7 Lectures)

## MODULE - III

Measurement of Force and Torque: and pressure Standards, Measuring Methods, Comparative study of different types of forces and torque Measuring systems. Description and working Principle of different types of Transducers for Measuring Pressure, Measurements of High Pressure and low pressure, calibration method.

(6 Lectures)

## MODULE - IV

Measurement of Humidity and Temperature: Introduction, Different types of Transducers for measurement of Humidity, their performance characteristics and limitations.
Flow Measurement: Introduction, Principle of operation of various obstruction meters for compressible and incompressible fluid flow measurement, variable Area meter and other important flow meters and visualization methods.

(7 Lectures)

## MODULE - V

Different types of Transducers: for Measurements of low and medium temperatures pyrometers, Temperature indicators, problems in temperature measurement.

(6 Lectures)

## MODULE - VI

Measurement of Speed and Vibration: Velocity Acceleration: Speedometers, velocity measurement, Accelerometers, encoders, calibration and uses. Different pick-ups and their limitations Measurement of Radio-isotopes, Measurement of Radio activity.

(6 Lectures)

## MODULE - VII

Coordinate Measuring Machines: CMM Construction, operation and programming CMM Application and Benefits, surface measurement, Stylus Instruments and other modern surface measuring Techniques.

(6 Lectures)

**Reference Books**:
1. Mechanical Measurement by Beckwidth and Buck (Edn. 1965, Addison Wesley Publishing Co. Inc. London)
2. Measurement systems, Application and Design by Docblin (Edn. 1976, Publisher TMH)
3. Introduction to Microprocesors by A.P. Mathur 2nd Edn. 1984, Publisher TMH.
4. Engineering Measurements and Instrumentation by Adams L.F. (Edition 1975, London English University Press).
5. Instrumentation Measurement and Analysis by B.C. Nakra, K.K. Choudhary (Edn. 1985, Publisher TMH, New Delhi).
6. Automation, Production system & Computer Integrated Manufacturing by Mikell. P. Groover, 2nd edition 2001, Person Education Asia.

| ME4307 | STEAM POWER SYSTEM | 1.0 |
|---|---|---|

**MODULE - I**
**Introduction:** Components of steam power systems, Rankine cycle and modified Rankine cycle on p-v, h-s & T-s diagrams. Use of steam table and chart.

[3 Lectures]

**MODULE - II**
**Steam Generators:** Introduction and classifications, Fire tube and water tube boilers, Mountings and accessories of boilers, Different types of boilers, High pressure and Modern Boilers – constructional details and functioning, Boiler Draught its classification, chimney height, Discharge through chimney. Boiler performance-equivalent evaporation, Boiler efficiency, heat balance.

[11 Lectures]

**MODULE - III**
**Steam Engine:** Simple and compound steam engine, ideal and actual indicator diagrams, diagram factor, mep, ip, bp, mechanical efficiency, thermal efficiency.

[4 Lectures]

**MODULE IV**
**Steam Turbines:** Impulse and Reaction turbine, velocity diagram, compounding of turbines, Degree of reaction, height of reaction blading, state point locus for single stage and multi-stage turbines, condition curves, losses in steam turbines, governing of steam turbines.

[12 Lectures]

**MODULE - V**
**Improved Turbinses:** Back-pressure and pass-out Turbine, Regenerative feed heating cycles, Binary vapour cycle.

[5 Lectures]

**MODULE- VI**
**Steam condensers:** Classification of condensers, sources of air in condenser, effects of air leakage in condenser, vacuum efficiency, condenser efficiency, Air pumps, cooling water calculations.

[5 Lectures]

**MODULE –VII**
**Steam Nozzles:** Steam flow through nozzles-velocity of steam and discharge through nozzle and condition for maximum discharge, nozzle efficiency, supersaturated expansion of steam, general relationship between area, velocity and pressure in nozzle flow, steam injector.

[5 Lectures]

**Recommended Books:**

1.    The Theory and Practice of Heat Engine – D.A. Rangham, Camb. Univ. Press.
2.    Elements of Heat Engine – Pandey & Saha
3.    Steam and Gas Turbine – R. Yadav
4.    Thermal Engineering – R.K.Rajput.

## MODULE -I
**Introduction:** Introduction of Energy Conversions, Thermo-mechanical Energy conversion in I.C. Engines, E.C. Engines, Gas turbines and Steam turbines, Combustion processes and calculation of air requirements, Actual and theoretical air- fuel ratio.

[5 Lectures]

## MODULE - II
**I.C. Engines:** Classification of I.C. Engines- two stroke and four stroke engines, Spark ignition and compression ignition engines, Petrol and diesel engines, Indicated and brake power of S.I. Engines and C.I. Engines, Brake mean effective pressure (bmep), Mechanical and thermal efficiencies of engines.

[8 Lectures]

## MODULE - III
**Steam Power Systems:** Components of steam power system, Rankine cycle and modified Rankine cycle, Steam Generators- introduction and classification, Fire tube and water tube boilers, Mountings and accessories of boilers, boiler performance-equivalent evaporation, boiler efficiency, use of steam tables.

[8 Lectures]

## MODULE - IV
**Steam Engine:** Simple and compound steam engines, ideal and actual indicator diagrams, diagram factor, mep, ip, bp, mechanical efficiency, thermal efficiency.

[4 Lectures]

## MODULE - V
**Steam Turbine:** Impulse and reaction turbines, compounding of turbines, velocity diagram for single and multi-stage impulse turbine, Impulse – reaction turbine, difference between impulse and reaction turbines.

[7 Lectures]

## MODULE - VI
**Air compressors:** Introduction and working principles with constructional details of reciprocating and rotary type compressors, single and double - stage air compressors, single stage and multi-stage compressors, indicator diagram, equation of shaft work for compressor with and without clearance, volumetric efficiency.

[8 Lectures]

## MODULE - VII
**Refrigeration systems:** Air refrigeration cycles - Reversed Carnot cycle, Reversed Jule & Brayton cycle, and Bell-Coleman cycle, vapour compression cycles, use of refrigeration table and charts, determination of coefficient of performance of various cycles, Absorption refrigeration systems.

[5 Lectures]


**Recommended Books:**

1.      The Theory and Practice of Heat Engine – D.A. Rangham, Camb. Univ. Press.
2.      Elements of Heat Engine – Pandey & Saha
3.      Thermal Engineering – R.K.Rajput.

| MA5001 | NUMERICAL TECHNIQUES IN ENGINEERING | 1.0 |
|---|---|---|

Types of errors and analysis, Errors in series approximation

(1L)

Solution of non-linear algebraic equations, Complex roots by lin-Bairstow method.

(3L)

**Solution of system of linear equations:**
Gauss elimination method, Gauss-Jorden elimination method, Crouts Reduction Method, Jacobi's method, Gauss-Seidal iteration method.

(5L)

**Eigen value problems:**
Least Square's method, Fitting a straight line, a parabola, curve of the form y=axb and exponential curve.

**Interpolation:**

(4L)

Newton's Forward Interpolation formula, Newton Backward Interpolation formula, Lagrange's Interpolation formula, Newton's Divided Difference interpolation formula.

**Numerical Differentiation and integration:**

(5L)

Differentiation using difference operator, Differentiation using Interpolation, Newton-Cotes Integration formula, Trapezoidal rule, Simpson's rule.

**Ordinary Differential Equation:**

(5L)

Euler's Method, Range Kutta Method, Predictor-Corrector Method.

(4L)

**Partial Differential Equation:**

(12 L)

Classification of Partial Differential Equations, Solutions of Partial Differential Equations, Parabolic: Explicit Method, Implicit Methods Elliptic: Iterative Methods, Hyperbolic: Explicit Methods.

**Books Suggested:**

1. Introductory method of Numerical analysis - Prentice-Hall of India New Delhi, S.S.Sastry.
2. Computer Oriented Numerical Methods - Prentice-Hall of India, V. Rajaraman.
3. Finite Differences & Numerical Analysis - S Chand & Co. Ltd. New Delhi - H.C. Saxena.
4. Introduction to Numerical Analysis - Addision - Wesley Publishing Company - Proberg.
5. Introduction to Numerical Analysis - Tata Mc Graw -Hill Publishing Company - F.E. Hildebrand.
6. Numerical methods for Scientist and Engineers by K. Shankara Rao, Estern Economy Edition, PHI, 2001.

**MODULES – I & II**
**Theory of Metal Cutting:** Geometry of single point cutting tool, Orthogonal and oblique cutting, Tool forces in orthogonal cutting, types of chips, machinability, tool failure, tool life, cutting fluids and cutting tool materials.

(10 Lectures)

**MODULE - III & IV**
**Machine Tools:** Constructional features, specification, operations and drives of basic machine tools such as lathe, shaper, planer, drilling machine, and milling machine. Indexing in milling operations. Working principles of capston and Turret lathes.

(20 Lectures)

**MODULE – V, VII & VII**
**Grinding and finishing operations:** Cylindrical, surface and centreless grinding; Broaching, lapping, honing and buffing.

(8 Lectures)

Gear cutting by forming and generating methods.

(4 Lectures)

Concept and applications of Jigs and Fixtures.

(3 Lectures)

**Text Books:**

1.     Principles of Manufacturing materials and proceses – J.S. Campbell.
2.     Elements of Workshop Technology, Vol. II – Hajara Choudhury

**Reference Books**:

1.     HMT Production Technology Hand Book.
2.     Manufacturing Technology by Dr. B. Kumar, Khanna Publishers, new Delhi.

**MODULE - I**
**Theories of elastic failure:** Introduction, significance and comparison of various theories. Equivalent bending moment and equivalent torque.

(6 Lectures)

**MODULE - II**
**Unsymmetrical bending:** Limitations of flexural formula. Bending stresses in beams with loads not acting in the plane of symmetry of the cross-section. Flexural formulas for stresses with reference to principal axes of inertia of the cross-section.

(7 Lectures)

**MODULE - III**
**Shear Centre:** Theory of shear flow, shear flow diagrams and shear centre for thin-walled symmetrical sections.

(6 Lectures)

**MODULE - IV**
**Bending of curved beams:** Beams of small and large initial curvature, evaluation of circumferential stresses. Stresses and deformation of closed rings.

(7 Lectures)

**MODULE - V**
**Thin and thick cylinders:** Radial and circumferential stresses, stresses produced due to shrink fit.

(5 Lectures)

**MODULE -VI**
**Rotating Disc:** Stresses in disc of uniform thickness and uniform strength.

(5 Lectures)

**MODULE - VII**
**Springs:** Open coiled helical spring, leaf spring and spiral spring.

(5 Lectures)

**Fattique & creep**

(4 Lectures)


**Text Books:**

1.      Advanced Mechanics of Material - Seely & Smith
2.      Strength of Materials Vol. 1 and 2 - timshenko
3.      Strength of Materials - F.L. Singer.

**MODULE - I**
**Impact of free Jets:** Force exerted by fluid jet on stationary and moving flat and curved plates, Euler's equation of turbine, Impulse and reaction turbine, velocity triangles.

(7 Lectures)

**MODULE - II**
Pelton and Francis turbines, velocity triangles, power and efficiency calculations, constructional details and general hydraulic design.

(8 Lectures)

**MODULE - III**
Kaplan turbine, velocity triangles, power and efficiency calculations, constructional details. Bulb turbines.

(4 Lectures)

**MODULE - IV**
**Centrifugal pumps:** Classification, vector diagram, heads, power and efficiency calculation, Blade profiles, starting speed, cavitations.

(5 Lectures)

**MODULE - V**
**Reciprocating pump:** Construction and working of single and double acting reciprocating pumps, theory of indicator diagram, slip and effect of frinction and acceleration, power required, overall efficiency, air vessels, Performance characteristics of gear pumps, jet pumps, screw pump, vane pump.

(9 Lectures)

**MODULE - VI**
**Fluid coupling and torque converter:** Theory characteristics and uses. Performance characteristics and governing of turbines.

(6 Lectures)

**MODULE - VII**
**Selection of turbines & pumps:** Model testing, principle of similarity, specific quantities & unit quantities.

(6 Lectures)

**Text Books:**

1. Hydraulics and Fluid Mechanics by Modi and Seth
2. Fluid Mechanics and Hydraulic machines by R.K. Bansal.

**Reference Books:**

1. Fluid Mechanics and Machinery by D. Rama. Durgaiah
2. Hydraulic Machines by J. Lal
3. Fluid Mechanics by V.L. Streeter.

| ME5105 | MECHATRONICS | 1.0 |

**MODULE – I**
**Fundamental Of Mechatronics**
Definition and Concepts of Mechatronics, Conventional system Vs. Mechatronics System, Need and Role of Mechatronics in Design,  Manufacturing and Factory Automation.

(6 Lectures )

**MODULE – II**
Hardware components for Mechatronics, Binary logic, K-MapMinimization, Transducer signal conditioning  and devices for data conversion

(5 Lectures)

**MODULE – III**
PLC Lader programming, counting Jumps timers.

(4 Lectures)

**MODULE – IV**
Signals, systems and control
Introduction to signals, system and control system, system Representation, Linearization of Non-linear systems, Time Delays, Measures of system Performance.

(6 Lectures)

**MODULE – V**
**Sensors and Transducers**
Different parameters of sensor performance, types of sensors used in Mechatronic systems.

(6 Lectures )

**MODULE – VI**
**Structure and Properties of Materials:**
Macroscopic physical properties, Microscopic properties.

(6 Lectures)

**MODULE - VII**
**Real time Interfacing and Mechatronic application:**
Data Acquisition systems
Advance Application in Mechatronics, Condition monitoring, Micro-sensors artificial intelligence fuzzy logic.

(12 Lectures)


**Text Books:**

1. Mechatronics System Design by Devdas Shetty, Richard A. Kolk, PWS Publishing Company (1997).
2. Mechatronics Electronic Control Systems in Mechanical and Electrical Engineering 2nd Edition by W. Bolton (2002).

**MODULE – I**
Definition of Refrigeration and Air-conditioning, Introduction and Basic concepts. Air-cycle Refrigeration, its application in air-craft refrigeration Evaporative cooling system, Boot strap cooling system, Regenerative cooling system, Reduced Ambient system.

(7Lectures)

**MODULE – II**
Simple vapour compression Refrigeration systems, Compound  vapour compression Refrigeration systems and its applications.

(6 Lectures)

**MODULE – III**
Vapour Absorption Refrigeration system and its applicantions. Thermo-electric Refrigeration systems, Steam jet Refrigeration system.

(7 Lectures)

**MODULE – IV**
Function and classification of compressors, construction and working of reciprocating compressors, Work done and volumetric efficiency.
Multi-stage compression and their advantages Centrifugal and Rotary Compressors.

(10 Lectures)

**MODULE – V**
**Properties of Refrigerants and eco-friendly refrigerants.**
Low Temperature Refrigeration and its applications.

(6 Lectures)

**MODULE – VI**
Psychrometry, Cooling load calculation and Air-conditioning, systems and accessories.

(9 Lectures)

**MODULE – VII**
Cooling Towers & Cooling Ponds.

(4 Lectures)

**Text Books:**

1.     A Text book of Refrigeration & Air-conditioning – R.S. Khurmi & J.K. Gupta.
2.     Refirgeration & Air-conditioning – Arora & Domukndwar
3.     Refrigeration & Air-conditioning – C.P. Arora.

**Reference books**:

1.     Refrigeration & Air-conditioning – R.C. Jordan & G.B. Priester.
2.     Refrigeration & Air-conditioning – Manohar Prasad

| MA6101 | OPERATIONS RESEARCH | 1.0 |
|---|---|---|

Treatment of the subject is to be application oriented, Theorems and derivations are not necessary.

**MODULES - I**
Scope and limitations of O.R., Concept of Linear and Non-Linear Programming.
(2 Lectures)
**Linear Programming:** Mathematical formulation of the problem, Graphical solution, The simplex method, Charnes method of penalties, Concept of duality, Dual simplex method.
(10 Lectures)

**MODULE - II**
**Transportation Model:** Basic feasible solutions by different methods, Finding optimal solutions, Degeneracy in transportation problems, Unbalanced transportation problems.
(7 Lectures)

**MODULE - III**
**Assignment Model:** Balanced and Unbalanced assignments, Assignments to given schedules.
(6 Lectures)

**MODULE - IV**

**Sequencing:**
Processing of 2 jobs through machines - graphical method.
Processing of n jobs through two machines.
Processing n jobs through three machines.
(5 Lectures)

**MODULE - V**

**Queuing Model:** Queuing sysems and their characteristics. The M/M/1/FIFO/queuing systems.
(5 Lectures)
**PERT & CPM:** Network construction. Determining the critial path, Floats, Total and free floats.

**MODULE - VI**
Scheduling by networks, project duration, variance under probabilitic models, prediction of date of completion, Elements of Crashing of simple networks.
(10 Lectures)

**Text Books:**

1.      Operations Research - Kanti Swaroop
2.      Linear Programming - Hadley
3.      Quantitative in Management Technique: N.D.Vohra
4.      Operations Research: P.K. Gupta & D.S.Hira.

**MODULE -I**

Patterns, Pattern materials, types of Patterns, Pattern allowances.

Mould and Core making properties of moulding and core sands, Sand testing, Machine moulding.

(6 Lectures)

**MODULE -II**

Special Casting Processes: Centrifugal casting, investment casting, Die casting and shell moulding.
Working principle and operation of cupola.

(7 Lectures)

**MODULE -III**

Cleaning of casting, inspection of casting, casting defects.
Gating, Risering and solidification of casting.

(7 Lectures)

**MODULE -IV**

Principle, working and applications of oxy-acetylene gas welding and gas cutting.

(6 Lectures)

**MODULE -V**

Electric Arc Welding. MMAW, SAW, MIG, Electroslag, TIG and Plasma Arc welding.
Thermit welding.

(7 Lectures)

**MODULE -VI**

Resistance welding. Spot, seam, projection and Butt welding.
Soldering and Brazing

(7 Lectures)

**MODULE -VII**

Basic concepts of hot and cold working, shearing and forming operations.

(5 Lectures)

**Reference Books:**

1. Foundry Technology, - K.P. Sinha and D.B. Goel, Standard Publishers and distributors, Delhi.
2. Welding and Welding Technology - Richard L. Little (TMH Edition)
3. Text Book of Welding Technology - O.P. Khanna.
4. Manufacturing Technology - Dr. B. Kumar, Khanna Publishers.

**MODULE – I**
**Basic Concepts:**
Introduction of Computer Aided Design, The Design Process, Product Cycle, CAD/CAM Developments, Definition of CAD/CAM Tools, Hardware and Software requirement of CAD, Engineering Application of CAD.

(4 Lectures)

**MODULE - II**
**Computer Graphics:**
Graphic System: CRT, Raster Scan system and Display process, Random Scan System and display, direct view storage tubes.
Output primitive: Line draw algorith – DDA & Bresenhems, cirle generating algorithm – Mid point circle Algorithm.

(7 Lectures)

**MODULE – III**
**Geometric Transformations:**
2D & 3D Transformations. Translation, Rotation, Scaling, Reflection, Homogeneous co-ordinates, windowing & clipping, View coordinate Reference frame, point & Line clipping algorithm.

(7 Lectures)

**MODULE - IV**
**urve Surface & Solid Modelling:**
2D Conic & 3D Hermite, Bazier & B-spline curves. Bazier & B-Spline surfaces. The various surface representation scheme & techniques. Geometric modeling: Wire frame, surface & solid modeling. Techniques for volume modeling. Boundary Representation and coustructive Solid Geometry method.

(8 Lectures)

**MODULE – V**
**Optimization:**
Elements of Optimization, Formulation of design problems for optimization. Classification of optimization problems. Solution for single variable & multivariable search method. Graphical method for solution of 2 variables design problem, Johnson's method

(6 Lectures)

**MODULE – VI**
Finite Element Analysis, STEPS for Finite Element Analysis. Analysis of 1D, 2D structural problems.

(5 Lectures)

**MODULE – VI**
**Computer Aided Design:**
Basic concept, Computer Aided Design of shaft using RDBMS & drafting package on application software like visual basic. Introduction to solid modeling package like Inventor series & Pro/E.

(8 Lectures)

**Text Book:**

1.      CAD/CAM – by Ibrahim Zeid ,Tata McGraw Hill Publishing Comp. Ltd., New Delhi

**Reference Books:**

1.      Computer Graphics – by Hearn & Baker, Publication Prentice Hall.
2.      CAD/CAM – by Chirs McMohan, Publication: Pearson Education Asia.
3.      Computer Aided Design – by R.K. Srivastava, Umesh Publication.

## MODULE – I
**MECHANISMS:** Kinematic concept of Link, Kinematic chain, Mechanism, degree of freedom, Inversions of four bar mechanism, single slider crank mechanism and double slider crank mechanisms, Straight line motion mechanism and Copying mechanism.

(5 Lectures)

## MODULE – II
**MOTION ANALYSIS:**
Types of motion: Kinematic and Dynamic quantitites; Vector diagrams, Instantaneous centers.Velocity and acceleration diagram of plane mechanism including Coriolis components. Instantaneous center method. Klein's construction, Analytical treatment.

(10 Lectures)

## MODULE – III
**FORCE ANALYSIS:**
Static force analysis, friction effets, dynamic force analysis, equivalent system.

(6 Lectures)

## MODULE – IV
**FLYWHEEL:** Turning Moment on crankshafts, Turning Moment diagram, Fluctuation of energy and speed and determination of M.I. of fly wheel.

( 5 Lectures)

## MODULE – V
GEARS, Fundamental laws of gearing: classification and basic terminology, involute tooth profile and its kinematic consideration, spur gears, other types of gears, standards in tooth forms.

(8 Lectures)

## MODULE – VI
Gear trains : Simple, compound and epi-cyclic gear trains

(5 Lectures)

## MODULE – VII
**CAMS:** Various types of cams, Displacement, velocity and acceleration of followers, Graphical determination of CAM profiles with different types of followers, specified Cam Profile.                                                    (6 Lectures)

**Text Book:**

1.     Theory of Machine by Thomas Beven

**Reference Books:**

1.     Theory of Machines and Mechanism by Ghosh and Malik
2.     Mechanism and Machine Theory by J.S. Rao and R.V. Dukkibati
3.     Theory of Machine by S.S. Rattan, Tata McGrow Hill.

| ME6205 | DESIGN OF MACHINE ELEMENTS | 1.0 |

**MODULE -I**
Principles of Machine Design, standardization, designation and selection of materials, aesthetic and ergonomic considerations in design, Preferred numbers, Tolerances.

(6 Lectures)

**MODULE -II**
Design against static and fluctuating loads.

(6 Lectures)

**MODULE –III**
Threaded Joints, Cotter and Knuckle joints.

(6 Lectures)

**MODULE –IV**
Riveted and Welded Joints.

(7 Lectures)

**MODULE -V**
Shafts, keys, couplings, Belt, Rope and chain drives

(7 Lectures)

**MODULE -VI**
Power screws, Screw Jack, Helical and leaf springs.

(7 Lectures)

**MODULE –VII**
Clutches and Brakes

(6 Lectures)

**Text Books:**

1. Machine Design by Maleev and Hatman, CBS Publisher & Distributor, New Delhi, 1983.
2. Mechanical Engineering Design by J.F. Shegley, McGraw Hill Book 3.    Company, U.S.A., 1986.

**Reference Books:**

1. Design of Machine  by Khurmi and Gupta, S. Chand and Company Ltd., New Delhi, 2000.
2. Machine Design, Sharma and Agarwal, S.K. Kataria and Sons, New Delhi, 2001.
3.  Design of Machine Elements, VB Bhandari, Tata McGraw Hill, New Delhi 1999.
4. Hand book of Properties of Engineering Materials and Design Data far Machine Elements, Abdulla Shariff, Dhanpat Rai & Sons, New Delhi – 2001.

| ME6207 | I.C. ENGINES & GAS TURBINES | 1.0 |

**MODULE -I**
**Introduction:** Classification of I.C. Engine, fundamental difference between S.I. and C.I. engines, Comparison of two stroke and four stroke engine, Air Standard Cycles: Otto, Diesel, Dual, Joule and Brayton cycles, Fuel-air Cycles and their analysis.

(7 Lectures)

**MODULE -II**
**Fuels and combustion:** Different types of fuels and their properties, chemical composition, octane and cetane number, knocking rating, additives, stochiometric reaction.

Combustion in S.I. engines, stages, ignition lag, factors affecting ignition lag, flame propogation and its factors, knocking and its factors, control, measurement of knock. Combustion in C.I. engines, stages of combustion, delay period and affecting factors, detonation and affecting factors, control and comparison with knocking of S.I. engines, rating of C.I. engine fuels.

(11 Lectures)

**MODULE -III**
**Carburation, Injection and supercharging:** Introduction, derivation of choke jet ratio of a simple carburetor, design of carburetor, MPFI system. Injection system of C.I. engines, Introduction of supercharging, its purpose, Thermodynamic cycles of supercharged engines, efficiency of supercharged engines.

(7 Lectures)

**MODULE -IV**
**Engine Cooling and Lubrication:** Introduction, air and water cooling, thermo syphon, pump circulation Mechanism of lubrication, properties of lubricating oil, Role of Additives.

(5 Lectures)

**MODULE -V**
**Testing and Performance:** Introduction, measurement of air, fuel consumption, indicated power, brake power, Morse test, Heat balance sheet, governing of I.C. engine, performance parameter of S.I. and C.I. engine, performance map.

(3 Lectures)

**MODULE -VI**
**Gas turbine and Jet Propulsion:** Theory of gas turbine, thermodynamic analysis of Brayton cycle, and with regeneration, reheat, intercooling. Compressor and turbines isentropic efficiency, Analysis of cycle considering losses. Jet propulsion cycle, elementary idea of turbojet, Turbopropulsion, ramjet and pulses jet, Analysis of jet propulsion, Classification of Rocket propulsion.

(8 Lectures)

**MODULE -VII**
**Engine Emission and Green house effect:** Introduction, engine emissions and their effects, gasoline and diesel emission, methods of measuring pollutants, controlling of engine emission, Factors affecting green house effects.

(4 Lectures)

**Text Book:**

1.     Internal combustion engines by E.F.Obert.
2.     Gas turbine Theory by Cohen Roger.

**Reference Books:**

1.     A course in Internal Combustion Engines by M.L. Mathur and R.P. Sharma.
       Gas Turbine Jet and Rocket Propulsion by M.L.Mathur and R.P.Sharma.

| ME7101 | PRODUCTION AND MANAGERIAL ECONOMICS | 1.0 |
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**MODULE -I**
**Introduction to Economic system:**
Nature and Scope of Managerial Economics. Function and Responsibilities of Managerial Economics. Supply, Demand and Production Role of engineer in Engineering Economy. Physical and  Economic efficiency.

(6 Lectures)

**MODULE -II**
**Cost and Break even analysis:**
Cost introduction, Cost Structure, Elements of cost, First costs, operating cost and Sunk cost. Future and opportunity cost. Direct, Indirect and overhead costs, Fixed and variable costs. Incremental and Marginal costs, cash cost and Book costs, Total cost, standard cost Methods of allocating overhead costs. Breakeven analysis – Introduction,  Drawing Break-evencharts, Effects of different variables on Breakeven point, cost comparison of two or three alternatives by Break even points, Numerical evaluation of Break-even point. Advantages and limitations of Break-even analysis.

(7 Lectures)

**MODULE -III**
**Time value of money operations:**
Introduction, concept of Interest and Interest rate. Single sum and series of cash flow. Uniform and gradient series, Multiple compounding periods in a year. Continuous compounding Bonds, Installment financing. Shares, Debentures.

(10 Lectures)

**MODULE -IV**
**Recording of Business transaction:**
Accounting principles, Accounting ratios. Journal and ledger entries, Balance sheet, profit and loss statement. Single and double entry book keeping, Trial Balance.

(4 Lectures)

**MODULE -V**
**Comparison of alternatives & Replacement Analysis:**
Introduction, Basis of comparison. Common bases of comparison,  Present worth amount, Annual equivalent amount. Future worth amount, Rate of return, Mutually exclusive alternatives, Decision criteria for selection of investment proposals. Comparison of alternatives with unequal service lives, Introduction-Replacement Analysis, Reasons for Replacement, Methods of replacement analysis, equipment replacement policy, Factors for replacing equipments. Evaluation of replacement involving  sunk and maintenance cost. Economic life of an asset.

(8 Lectures)

**MODULE -VI**
**Depreciation and Income Tax considerations:**
Introduction, Methods of depreciation and their comparison, After tax cash flow, Effect of depreciation on income tax.

(5 Lectures)

**MODULE -VII**
**Decision Making under uncertainty:**
Decision making - Introduction, Laplace principle, Maximum and Minimax principles. Herwits principles, Introduction to sequential decision and decision tree in the evaluation of alternatives. Decision under risk sensitivity analysis.

(5 Lectures)

**Books:**

1.     Principles of Engineering Economy By E.L. Grant, W. Grant Ireson, the Ronald Press Co., New York.

2.     Engineering Economy By E.P. Deqarmos
3.     Engineering Economy By thursen.
4.     Managerial Economics By Varshney and Maheshwary.
5.     Business Economics By V.G. Mangkar

**MODULE -I**
Introductory concepts, modes of heat transfer – conduction, convection and radiation, basic equations and applications, generalized conduction differential equation, simple steady and unsteady state solution, one dimensional heat conduction without heat generation and with heat generation composite walls, cylinders and spheres, electrical analogs of thermal systems.

(8 Lectures)

**MODULE -II**
Extended surfaces (Fins) :   General equation, temperture distribution, heat flow, fin efficiency, effectiveness, variable area, circumferential fin, pin fin of variable section.

(6 Lectures)

**MODULE -III**
Radiation: Definition and laws of thermal radiation, black body, real surfaces, gray surfaces, radiation properties, shape factor, radiosity, irradiation, electrical analogy, three-surface system, radiation shield, gas radiation basics only.

(7 Lectures)

**MODULE -IV**
Convection: Natural and forced convection, concept of viscous and thermal boundary layers, laminar and turbulent flow, continuity equation, momentum equation, energy equation, solution for laminar flow, integral equation, dimensional analysis, Nusselt number correlations-constant heat flux, turbulent flow, flow across cylinders, flow across tube banks, force convection for internal flow-laminar & turbulent.

(8 Lectures)

**MODULE -V**
Natural convection: Grashoff number, analytical method, integral method, practical correlation, constant heat flux, horizontal and inclined flat surfaces, cylindrical surfaces, simplified correlation for air, combined free and forced convection.

(6 Lectures)

**MODULE -VI**
Heat Exchanger: Types of heat exchanger, LMTD method of analysis, correction factor concepts, NTU – effectiveness method of analysis, storage type exchangers, basic ideas of boiling process and mechanism.

(5 Lectures)

**MODULE -VII**
Mass Transfer: Molecular diffusion, equimolal counter diffusion, diffusion into a stationary medium, convective mass transfer, Numberical problems.

(5 Lectures)

**Books:**

1.      Heat and Mass Transfer by F. Kids
2.      Heat and Mass Transfer by J.P. Holman
3.      Heat  and Mass Transfer by C.P. Kothandraman
4.      Heat and Mass Transfer by  D.S.Kumar
5.      A course in Heat Transfer by Arora and Domkundwar

## MODULE -I

**Balancing of revolving masses and locomotives:** Balancing of several masses revolving in the same plane and different planes. Primary and secondary unbalance in reciprocating engine mechanism, partial balancing of a reciprocating mass by a revolving mass; partial balancing of two cylinders un coupled locomotive engine, Hammer blow; variation of tractive effort, swaying. Couples, coupled wheels of a locimotive.

Lectures)

## MODULE -II

**Balancing of Engines:** Balancing of in line, radial and V-type multicylinder engines, Direct and Reverse cranks. Engine firing timings, principles of balancing machines.

(6 Lectures)

## MODULE -III

**Governors:** Centrifugal governors – Porter, Proel, Hartnell; Sensitiveness hunting, Isochronism stability Effort and Power, Effect of friction on sensitiveness.

(6 Lectures)

## MODULE -IV

**Gyroscope:** Gyroscopic couple, Gyroscopic effect on naval ship, stability of two wheeled and Four wheeled vehicles.

(6 Lectures)

## MODULE -V

**Friction Devices:** Coulomb friction, pivot and collars, power screws, plate and cone clutches, Band and Block Brakes, shoe brakes, Roller friction, Antifriction bearing, Roller bearings.

(7 Lectures)

## MODULE -VI

**Free Vibration:** Linear single degree of freedom systems, longitudinal, transverse and torsional vibration with un-damping & damping.

(6 Lectures)

## MODULE -VII

**Forced Vibration:** forced vibration of single degree of freedom system with viscous damping, vibration isolation, Transmissibility, torsional osicillation of two rotor, three rotor system; Holzer method for multirotor system.

(7 Lectures)

**Books:**

1. Mechanism and Machine Theory by J.S. Rao and R.V. Dukkipati
2. Theory of Machine by P.L. Balaney, Khanna Publication.
3. Theory of Machines by Thomas Beven.
4. Theory of Machines by S.S. Raltan.

**MODULE -I**
Design of Spur and  Helical gears, Reduction gear boxes

**MODULE -II**
Design of Bevel and Werm gears, Didfferential gear boxes.

**MODULE -III**
Rolling contact and sliding contact bearings.

**MODULE -IV**
Design of I.C. Engine parts: cylinder, Piston, connecting rod, crank shaft and valve.

**MODULE -V**
Design of centrifugal pump.

**MODULE -VI**
Pressure vessels, supports, openings

**MODULE -VII**
Optimization and Probabilistic approach in Machine Design.


**Reference Books:**

1.      Machine Design, Maleev and Hartman, CBS Publisher & Distributor, New Delhi, 1983.
2.      Mechanical Engineering Design, J.F. Shighly, McGraw Hill Book Company, U.S.A. 1986.
3.      Machine Design, Khurmi and Gupta, S. Chanc and Company Ltd., New Delhi, 2000.
4.      Machine Design, Sharma and Agarwal, S.K. Kataria and Sons, New Delhi, 2001.
5.      Design of Machine Elements, V.B. Bhandari, Tata McGraw Hill, New Delhi, 1999.
6.      Mechanical Reliability, L.S. Shrinath, Affiliated East West Press, New Delhi, 2002.

7.      Hand Book of Properties of Engineering materials and Design Data for Machine Elements, Abdulla Shariff, Dhanptat Rai & Co., New Delhi 2001.

**MODULE -I**
**Introduction:** Review of electricity generation in Indian context and energy scenario in India, Principal types of power plants, special feature, application and future trend of developments.

(5 Lectures)

**MODULE -II**
**Steam Power Plants:** Major components of power plant, fuels and their properties, storage, preparation, handling and burning, Ash handling and dust collection, Feed water treatment plants, cooling towers, insulation, Heat balance of power plant.

(8 Lectures)

**MODULE -III**
**Nuclear Power Plants:** Principle of power generation by nuclear fission and fusion, fuels for nuclear power plants, preparation and care, fertile materials and breeding.

(6 Lectures)

**MODULE -IV**
**Diesel and Gas Turbine Power Plants:** Introduction, field of use, air supply, and cleaning system, fuel storage and supply systems, cooling systems, lubricating and starting systems, comparative study of diesel and gas turbine plants.

(6 Lectures)

**MODULE -V**
**Hydraulic Power Plants:** Different types of hydraulic power plants, rain fall and run-off measurements and plotting of various curves for estimating power available with or without storage.

(8 Lectures)

**MODULE -VI**
**Energy Storage Methods:** Compressed air, Energy Storage flywheel, electrochemical energy storage, thermal energy storage.
Instrumentation and control methods used in different types of power plant.

(6 Lectures)

**MODULE -VII**
**Site selection and Economics of Power Plants:** Criterion for site selection of different types of power plants, cost consideration of different types of power plants, cost consideration for selection of different equipments, comparison of different types of power plants, tariff of power, load production methods to meet variable loads.

(6 Lectures)

**Books:**

1.      Power Plant Technology:  by M.M.E. Wakil, McGraw Hill Publication.
2.      Power Plant Engineering:  by N.K.Nag, T.M. H. Publication
3.      Power Plant Engineering:   by Arora & Domkundwar, Dhanpatrai Publication
4.      Power Plant Engineering: by Black & Veatch, CBS Publication.
5.      Power Plant Engineering: by F.T. Morse.

| ME8203 | INDUSTRIAL MANAGEMENT | 1.0 |
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## MODULE -I
### Management and Organisation:
Introduction and Definition of Management. Different functions of Management. Principles of Management. Definition and concept of organisation. Elements of organisation. Industrial enterprises and their relationship. Types of organisation their merits and demerits and application.

(6 Lectures)

## MODULE -II
### Product Design, Development, and Marketing Management:
Definition, Product design and development. Effect of design on cost. Considerations of good product design. Factors of product design, Requirements of good product design, sources of product design. Product development, causes and methods. Standardisation. Simplification and specialisation, product life cycle.

Definition, selling and marketing concepts, Aims, and objectives & function of Marketing. Marketing strategy, Market research. Sales forecasting - purpose and techniques. Advertising, Sales promotion, channels of distribution. Packaging, and pricing.

(8 Lectures)

## MODULE -III
### Materials Management (including Purchase and Stores Management):
Definition and objectives of purchase management, organisation function and duties of purchase department, Methods of purchasing. Purchasing forms, Purchase procedure, Definition and importance of stores, organisation of store department function and duties of storekeeper. Location and layout of stores. Physical verification of stores.

(5 Lectures)

## MODULE -IV
### Finance and Financial Management:
Purpose and sources of finance, Definition, Functions & objectives nature & scope and importance of Financial Management and goals of Financial Management. Capital Budgeting, Money conversion cycle.

(4 Lectures)

## MODULE -V
### Personnel Management and Industrial Legislation:
Definition and concept. Aims and objectives of personnel Management, Characteristics of a good personnel policy. Importance of labour Acts, Principles of labour legislation. Types of labour laws such as Factory act., Industrial dispute act, Workman's compensation act, wage payment act. Job evaluation, Merit rating performance appraisal.

(7 Lectures)

## MODULE -VI
### Production, Maintenance and Safety management :
Location and layout of plant, Production & productivity, Production Planning and Control, Functions of production Manager, Types of production systems, Inventory control, Economic batch quantity, objectives and importance of plant maintenance introduction, Duties, responsibilities, and organisation of maintenance department. Types of maintenance. Industrial safety and measures, causes and sources of accidents, losses due to accident, accident control, safety organization and programmes, safety education & training, first aid, duties of plant safety inspector and supervisor.

(8 Lectures)

## MODULE -VII
### Inspection and Quality Control:
Definition and concept, objectives of inspection, Function of Inspection department, Kinds of Inspection, Sampling inspection, sampling plans - single and double.

Statistical quality control, definition and concept of SQC Advantages of S.Q.C. Different types of control charts. Variable and Attribute charts. Application of control charts. Quality circle. TQM and ISO 9000 for Quality Management System.

(7 Lectures)

**Books:**

1. Industrial organisation and Engineering Economics - T.R. Banga and S.C. Sharma, Khanna Publishers.
2. Industrial Engineering and Production Management By M. Mahajan, Dhanpat Rai and Co.
3. Industrial Engineering and Management, Dr. O.P. Khanna, Dhanpat Rai & Co.

**MODULE -I**

Introduction: Energy needs and energy supply, conventional & non-conventional energy sources. Principle of operation and need of the non conventional energy sources. Present energy scenario.

(2 Lectures)

**Wind Energy:** Availability, site selection, different types of wind turbines, design criteria and material selection economics.

(6 Lectures)

**MODULE -II**

**Solar energy:** Solar geometry, Characteristics & estimation of solar radiation. Collector – flat plate & concentrating types. Heat loss calculation for flat plate type collector, Collector efficiency calculation, Selective paints & surfaces for them.

(10 Lectures)

**MODULE -III**

Thermal Storages and Solar ponds – principle & its uses.

**Solar Application:** Heating of air & water for building and other uses. Active & passive systems, solar pumps, solar power plant, solar cookers, solar refrigeration & air conditioning solar cookers, solar furnaces etc.

(7 Lectures)

**MODULE -IV**

**Bio-conversion:** Photosynthesis & generation of bio-gas, digester and their design, selection of material, feed of digester, pyrolytic gasification, algae production & their uses.

(5 Lectures)

**MODULE -V**

**Geo-thermal Energy:** Sites, potentiality and limitation, study of different conversion system and other uses of geo-thermal sources.

(3 Lectures)

**MODULE -VI**

**Tidal Energy:** Sites, potentiality and possibility of harnessing from site, limitation. Different method of using tidal power.

(3 Lectures)

**MODULE -VII**

**Ocean Thermal Energy:** Principle of utilization and its limitation description of few system. Other Non-Conventional Sources: Hydrogen energy, its production and applications. Fluidized bed combustions, waste product energy.

(6 Lectures)

**Books:**
1.      Non-conventional Energy Sources – G.D. Rai
2.      Solar Energy –Garg and Prakash
3.      Solar Energy Utilization – G.D. Rai
4.      Solar Thermal energy – Peter J. Lunde

**MODULE -I**
**Introduction**
Environment and Ecology problem, Fossil fuel related pollutants in the environment, Environmental Impacts of Hydro-electric, Nuclear energy and Chemicals, forwards a solution.

(4 Lectures)

**MODULE -II**
**Air Pollution:**
Definition and Scales of concentration, classification and properties of air pollutants, Emission on sources and their classification. Air pollution laws and standards, Inversion. Ambient air sampling, stack sampling, sampling system, analysis of air pollutants.

(6 Lectures)

**MODULE -III**
Air Pollution Control Methods And Equipments
Source correction methods, cleaning of gaseous effluents, particulate emission control, selection of a particulate collector, control of gaseous emission, combustion.

(9 Lectures)

**MODULE -IV**
**Water Pollution:**
Hydrologic cycle and water quality, origin of waste water and its composition, Type of water pollutants and their effects, water pollution laws and standards, waste water sampling and analysis, water quality standard, waste water treatment, Biological systems (Aerobic and Faculative Ponds), Recovery of material from process effluents.

(10 Lectures)

**MODULE -V**
**Noise Pollution:**
Different noise environments and their sources, measurement of noise and the equipments, Noise pollution laws and standards, vibration isolation and noise control in industries.

(5 Lectures)

**MODULE -VI**
**Solid Waste Management:**
Sources and classification, public health aspect, effluent treatment processes and solid waste management, solid-solid separation technique for recovery and reuse.

(5 Lectures)

**MODULE -VII**
**Case Study:**
Modern environmental assessment method, Pollution control in steel plants, coal industries, chemical industries, etc.

(6 Lectures)


**BOOKS RECOMMENDED**:

1.      Introduction to Environmental Sciences and Technology by G.M. Masters.
2.      System Approach to Air Pollution Control by Bibbero, R.J. & I.G. Young.

**MODULE -I**
**Review of I.C. Engines:**   Reciprocating Engines, The fundamental concepts and construction of S.I. and C.I. Engines (Two stroke and Four stroke engines),
Carburetion and Injection systems; Simple carburetor, modification of simple carburetor for conditions of Economy Power Accelerations. Idling and starting M.P.F.I. and F.I. system. Injection system of C.I. Engines, Bosch pump injection, Engine Lubrication system, Engine cooling system.

Electrical systems: Battery and cranking motor, the charging circuit, the ignition system and other electrical devices.

(13 Lectures)

**MODULE -II**
**Mechanics of Motor Vehicle:** Power for propulsion, rolling, air and grade resistance, Traction and tractive effort, road performance curves, Acceleration, gradeability and Draw par pull calculation of maximum acceleration, maximum acceleration, maximum tractive effort and reactions for different drivers.
(5 Lectures)

**MODULE -III**
**Power Transmission Systems:**  General arrangement of clutch, friction clutch, gear box, torque transmission, fluid flywheel, sliding, constant and synchromesh type gear box, epicyclic gear box, live axle transmission, Rear engine vehicles. Type of axles, Axle less transmissions, Four wheel drive.
(5 Lectures)

**MODULE -IV**
**Torque converters and Automatic transmission:**  Torque convertor, Turbo transmitter convertor, Automatic transmission, Borg-Warner transmission, Automatic control and central mechanism.
(6 Lectures)

**MODULE -V**
**Drive Lines and Rear Axles:** Universal joints, propeller shaft, Live rear axle, find drive, torque reaction, thrust systems, differentials, wheel bearing.
(5 Lectures)

**MODULE -VI**
**Front Axle,  Steering Mechanism and Carriage Unit:**  Primary construction, ackarman linkage, center point steering, Axle construction, steering mechanisms, wheel alignments, independent and dead axle suspension.
Frame design, types and actions of springs and dampers, chasis lubrication.
(7 Lectures)

**MODULE -VII**
**Brakes and Tyres:**   Functions and method of operation, types, linkages, hydraulic mechanism servo and power brakes, Types of tyre and tubes.
(4 Lectures)


**Books:**

1.     The Motor Vehicles by Newton and Steeds
2.     Automotive Mechanic: by W.H. Crouse
3.     Automotive Mechanics by Heitner

## MODULE -II
Introduction to Robotics, Classification of Robotics, Robot components, Robot degree of freedom, Robot Reference frames and coordinate system, Robot languages, Robot application.

(6 Lectures)

## MODULE -II
**Robotic Kinematics:** Robot as Mechanisms Representation of Transformation and Inverse of Transformation Matrices, Forward and Inverse kinematics of Robot.

(6 Lectures)

## MODULE -III
Denavit – Hartenberg Representation of Formal kinematic equation of Robots, Inverse kinematic solution & programming of Robots, Degeneracy and Dexterity.

(6 Lectures)

## MODULE -IV
**Differential Motions and velocities:** Differential Relationships, Jacobian, Differential changes between frames. Differential Motions of Robot and its Hand frame.

(6 Lectures)

## MODULE -V
Dynamic Analysis and Forces, Dynamic equations for Multi-degree of freedom Robots, Static Force Analysis of Robots. Transformation of forces and Moments between Design Project.

(6 Lectures)

## MODULE -VI
**Trajectory Planning:** Path Vs Trajectory, Joint space Vs Cartesian space Descriptions, Basics of Trajectory planning, Joint-space Trajectory planning, Cartesian space trajectory.

(6 Lectures)

## MODULE -VII
**Actuators & Sensors:** Characteristics of Actuating system, Comparison of Actuating systems, Hydraulic Devices, Pneumatic Devices, Electrical motor  Microprocessor control of Electric Motors, Sensor Characteristics, position velocity, acceleration, Force & pressures, Torque, Micro switches, Touch and Tectile, light and infra red, proximity sensors.

(9 Lectures)


**Text Books:**

1.  Introduction to Robotics Analysis System Application by S.Niku, Pearson Education Publication.

**Reference Book:**

1.  Introduction to Robotics by John J. Craig, Pearson Education Publication.
2.  Robotic Engineering by Richard D. Klafler, Thomas S.A. Chmielewski & Michael Negin, Prentice Hall India Ltd. Publication.