| Branch: MECHANICAL | Year: II | Semester: Odd |
|---|---|---|
| Subject Code: ROE-038 | Subject Name: **:** Discrete Mathematics | |
| Course Outcomes: | 1. Understand the basic concepts of sets, relations and functions. | |
| | 2. Analyze the problems which are faced in engineering. | |
| | 3. Comprehend the meaning of proposition, tautology, contradiction and Quantifiers. | |
| | 4. Construct, analyze and evaluate the solutions of difference equation and recurrence relation. | |
| | 5. 6. Evaluate different algebraic structures under different binary operations as group, ring and field. | |
| | 6. Analyze the different graphs, trees and finite state machine. | |

| Syllabus: As per AKTU | |
|---|---|
| Unit 1 | Relation: Definition, types of relation, composition of relations, pictorial representation of relation, properties of relation, partial order relation.<br>Function: Definition and types of functions, composition of functions, recursively defined functions.<br>Group: Monoid, Semi-group, Abelian Group, Properties of groups, Cyclic Group, Permutation groups, Caley's Theorem, Rings and Fields (definition, examples and standard results). |
| Unit 2 | Propositional logic: Introduction to logic, logical connectives, truth tables, Tautologies, contradiction, normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity, predicate logic, universal and existential quantification. Notion of proofs: proof by implication, converse, inverse, contrapositive, negation, and contradiction, direct proof, proof by using truth table, proof by counter example. |
| Unit 3 | Combinatorics: Mathematical induction, recursive mathematical definitions, basics of counting, Cardinality and Countability, Pigeonhole principle, permutations, combinations, inclusion-exclusion. |
| Unit 4 | Recurrence relations (*n* th order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation), generating function, properties of generating functions (G.F.), Solution of recurrence relation using G.F, solution of combinatorial problem using G.F. |
| Unit 5 | Graphs: Graph terminology, types of graph, connected graphs, components of graph, Euler graph, Hamiltonian path and circuits, Graph coloring, Chromatic number. Tree: Definition, types of tree (rooted, binary), properties of trees, binary search tree, tree traversing (preorder, inorder, postorder). |

| Branch: MECHANICAL | Year: II | Semester: Odd |
|---|---|---|
| Subject Code: RVE-301 | Subject Name: : University Human Values & Professional Ethics | |
| Course Outcomes: | 1. Understand the need, concept and content of value-education in individual's life and modifies their aspirations for happiness & prosperity. | |
| | 2. Comprehend the term self-exploration and its application for self-evaluation and development. | |
| | 3. Reconstruct the concepts about different values & discriminate between them. | |
| | 4. Analyze the concept of co-existence & evaluate the program to ensure self regulation. | |
| | 5. Identify the holistic perception of harmony at level of self, family, society, nature and explain it by various examples. | |
| | 6. Apply professional ethics in their future profession & contribute for making a value based society. | |
| Syllabus: As per AKTU | | |
| Unit 1 | **UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**<br>1. Understanding the need, basic guidelines, content and process for Value Education<br>2. Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration<br>3. Continuous Happiness and Prosperity- A look at basic Human Aspirations<br>4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority<br>5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario<br>6. Method to fulfill the above human aspirations: understanding and living in **harmony** at various levels | |
| Unit 2 | **Understanding Harmony in the Human Being - Harmony in Myself!**<br>7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'<br>*8.* Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*<br>9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)<br>10. Understanding the characteristics and activities of 'I' and harmony in 'I'<br>11. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail<br>12. Programs to ensure *Sanyam* and *Swasthya* | |

| | |
|---|---|
| | - Practice Exercises and Case Studies will be taken up in Practice Sessions. |
| Unit 3 | **Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**<br>*13. Understanding Harmony in the family – the basic unit of human interaction*<br>*14.* Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;<br><br>Trust (*Vishwas)* and Respect (*Samman)* as the foundational values of relationship<br>15. Understanding the meaning of *Vishwas*; Difference between intention and competence<br>16. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship<br>*17.* Understanding the harmony in the society (society being an extension of family): *Samadhan, Samridhi, Abhay, Sah-astitva* as comprehensive Human Goals<br>18. Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj),* Universal Order (*Sarvabhaum Vyawastha )*- from family to world family!<br>- Practice Exercises and Case Studies will be taken up in Practice Sessions |
| Unit 4 | **Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**<br>*19.* Understanding the harmony in the Nature<br>20. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature<br>21. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space<br>22. Holistic perception of harmony at all levels of existence<br>- Practice Exercises and Case Studies will be taken up in Practice Sessions. |
| Unit 5 | **: Implications of the above Holistic Understanding of Harmony on Professional Ethics**<br>23. Natural acceptance of human values<br>24. Definitiveness of Ethical Human Conduct<br>25. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order<br>26. Competence in professional ethics:<br>a) Ability to utilize the professional competence for augmenting universal human order<br>b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,<br>c) Ability to identify and develop appropriate technologies and management patterns for above production systems.<br>27. Case studies of typical holistic technologies, management models and production systems |

| | |
|---|---|
| | 28. Strategy for transition from the present state to Universal Human Order:<br>a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers<br>b) At the level of society: as mutually enriching institutions and organizations |

| | | |
|---|---|---|
| Branch: MECHANICAL | Year: II | Semester: Odd |
| Subject Code: RCE-303 | Subject Name: : Fluid Mechanics | |
| Course Outcomes: | 1. Apply basic principles of fluid statics to determine forces on planar and curved surfaces that are submerged in static fluid. | |
| | 2. Distinguish various types of fluid flows using continuity equation, stream function and velocity potential function. | |
| | 3. Apply principles of dimensional analysis to form dimensionless numbers. | |
| | 4. Apply the Bernoulli's equation to fluid measurement problems. | |
| | 5. Determine flow rates, pressure changes, minor and major head losses for viscous flows through pipes and pipe networks. | |
| | 6. Understand the concepts of laminar and turbulent boundary layers and use the momentum integral to determine integral thicknesses, wall shear stresses, and skin friction coefficients. | |
| Syllabus: As per AKTU | | |
| Unit 1 | Fluid and continuum, Physical properties of fluids, Rheology of fluids. Pressure-density-height relationship, manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis. | |
| Unit 2 | Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows, one, two and three dimensional flows, streamlines, continuity equation for 3D and 1D flows, circulation, stream function and velocity potential. | |
| Unit 3 | Potential Flow: source, sink, doublet and half-body. Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturimeter and bend meter, notches and weirs, momentum equation and its application to pipe bends. resistance to flow, Minor losses in pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks. | |
| Unit 4 | Equation of motion for laminar flow through pipes, Stokes' law, transition from | |

| | |
|---|---|
| | laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control. |
| Unit 5 | Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect. Similarity Laws: geometric, kinematics and dynamic similarity, undistorted and distorted model studies, Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance |

| | | |
|---|---|---|
| Branch: MECHANICAL | Year: II | Semester: Odd |
| Subject Code: RME-301 | Subject Name: : Material Science | |
| Course Outcomes: | 1. Understand the atomic and crystal structure of materials. | |
| | 2. Understand the mechanical properties & testing of materials. | |
| | 3. Understand the phase diagram of metal and alloys. | |
| | 4. Understand the microstructure and heat treatment of metals and alloys. | |
| | 5. Understand the properties and applications of composite materials, polymers and ceramics. | |
| | 6. Understand smart materials and Nano-materials. | |
| Syllabus: As per AKTU | | |
| Unit 1 | **Introduction:** Importance of materials, historical perspective, Future aspects of engg. materials.<br>**Crystal Structure:** brief on BCC, FCC and HCP Structures, coordination number and atomic packing factors. Bravais lattices, Miller indices, crystal imperfections-point line and surface imperfections. Atomic Diffusion: Phenomenon, Ficks laws of diffusion, factors affecting diffusion.<br>**Ferrous and non-ferrous materials:** Properties, Composition and uses of Grey cast iron, malleable iron, SG iron and steel, copper alloys-brasses and bronzes, Aluminium alloys. Introduction to BIS & ASTM codes and practice on material and testing. | |
| Unit 2 | **Mechanical Behaviour:** Stress-strain diagram showing ductile and brittle behaviour of materials, mechanical properties in plastic range, yield strength off set yield strength, ductility, ultimate tensile strength, toughness, Plastic deformation of single crystal by slip and twinning, Hardness Tests.<br>**Fracture Creep Fatigue:** Fracture: Type I, Type II and Type III. Creep: Description of the phenomenon with examples. Three stages of creep, creep properties, stress relaxation. Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram. | |
| Unit 3 | **Solidification:** Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures. Phase Diagram I: Solid | |

| | |
|---|---|
| | solutions Hume Rothary rule, substitutional and interstitial solid solutions, intermediate phases, Gibbs phase rule.<br>**Phase Diagram:** Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons, invariant reactions. |
| Unit 4 | **Heat Treating of Metals:** TTT curves, continuous cooling curves, annealing and its types. Normalizing, hardening, tempering, mastempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminium-copper alloys.<br>Comparative study of microstructure of various Ferrous, nonferrous metals and alloys. |
| Unit 5 | **Composite materials**: Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP's and MMC's advantages and application of composites.<br>**Ceramics:** Structure types and properties and applications of ceramics. Mechanical/ Electrical behavior and processing of Ceramics.<br>**Plastics:** Various types of polymers/ plastics and its applications. Mechanical behaviour and processing of plastics, Future of plastics. Introduction to Smart materials & Nano-materials and their potential applications. |

| Branch: MECHANICAL | Year: II | Semester: Odd |
|---|---|---|
| Subject Code: RME-302 | Subject Name: : Thermodynamics | |
| Course Outcomes: | 1. Explain fundamental concepts of thermodynamics. | |
| | 2. Apply first law of thermodynamics to open and closed systems. | |
| | 3. Understand second law of thermodynamics, concept of entropy and their applications. | |
| | 4. Understand availability and irreversibility and thermodynamic relations. | |
| | 5. Use properties of pure substance and air-water vapour mixture to analyze the open and closed systems. | |
| | 6. Analyze air and vapour compression refrigeration systems. | |
| Syllabus: As per AKTU | | |
| Unit 1 | **Review of Fundamental Concepts and Definitions:** Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi – static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Dalton's law, Amagat's law, Property of mixture of gases. **Zeroth law of thermodynamics:** Concept of Temperature and its' measurement, | |

| | |
|---|---|
| | Temperature scales.<br>**First law of thermodynamics:** Thermodynamic definition of work, Displacement work and flow work, Displacement work for various non flow processes, Joules' experiment, First law analysis for closed system (non flow processes), Internal energy and enthalpy. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer. |
| Unit 2 | **Second law of thermodynamics:** Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II.<br>**Entropy :** Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics. |
| Unit 3 | **Availability and Irreversibility**: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function.<br>**Thermodynamic relations:** Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve. Coefficient of volume expansion, Adiabatic and Isothermal compressibility. |
| Unit 4 | **Properties of steam and Rankine cycle:** Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Sub-cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables &Mollier chart, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle.<br>**Air-water vapour mixture and Psychrometry**: Psychometric terms and their definitions, Psychometric chart, Different Psychometric processes and their representation on Psychometric chart. |
| Unit 5 | **Refrigeration Cycles:** Reversed Carnot Cycle for gas and vapour. Refrigeration capacity, unit of refrigeration.Air Refrigeration cycles; Reversed Brayton Cycle and Bell Coleman Cycle. Vapour compression refrigeration cycle; simple saturated cycle and actual vapour compression refrigeration cycle. Analysis of cycles, effect of superheating, sub-cooling and change in evaporator and condenser pressure on performance of vapour compression refrigeration cycle. Refrigerants; their classification and desirable properties. Vapour absorption refrigeration system. |

| Branch: MECHANICAL | Year: II | Semester: Odd |
|---|---|---|
| Subject Code: RME-303 | Subject Name: : Mechanics of Solids | |
| Course Outcomes: | 1. Determine stress & strain, strain energy and design the elements considering equilibrium and theories of failure. | |
| | 2. Determine stresses, slope and deflection in beams by applying equation of elastic curve. | |
| | 3. Determine the stress, deflection & strain energy stored to design helical and laminated springs. | |
| | 4. Design Columns and Struts against crippling. | |
| | 5. Analyze and design thin & thick walled spherical and cylindrical shells. | |
| | 6. Design the curved beams and the elements under unsymmetrical bending. | |

| Syllabus: As per AKTU | |
|---|---|
| Unit 1 | **Compound stress and strains:** Introduction, normal stress and strain, shear stress and strain, stresses on inclines sections, strain energy, impact loads and stresses, state of plane stress, principal stress and strain, maximum shear stress, Mohr's stress circle, three dimensional state of stress & strain, equilibrium equations, generalized Hook's law, theories of failure. Thermal Stresses. |
| Unit 2 | **Stresses in Beams:** Pure Bending**,** normal stresses in beams, shear stresses in beams due to transverse and axial loads, composite beams.<br>**Deflection of Beams:** Equation of elastic curve, cantilever and simply supported beams, Macaulay's method, area moment method, fixed and continuous beams<br>**Torsion:** Torsion, combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes. |
| Unit 3 | **Helical and Leaf Springs:** Deflection of springs by energy method, helical springs under axial load and under axial twist (respectively for circular and square cross sections) axial load and twisting moment acting simultaneously both for open and closed coiled springs, laminated springs.<br>**Columns and Struts:** Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, struts with different end conditions, Euler's theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns in mechanical equipments and machines. |
| Unit 4 | **Thin cylinders & spheres:** Introduction, difference between thin walled and thick walled pressure vessels, Thin walled spheres and cylinders, hoop and axial stresses and strain, volumetric strain.<br>**Thick cylinders:** Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, compound cylinders, stresses in rotating shaft and cylinders, stresses due to interference fits. |
| Unit 5 | **Curved Beams:** Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in |

| | |
|---|---|
| | crane hooks, stress in circular rings subjected to tension or compression.<br>**Unsymmetrical Bending:** Properties of beam cross-section, slope of neutral axis, stress and deflection in unsymmetrical bending, determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel section. |