SYLLABUS FOR THE POSTS OF ASSISTANT PROFESSOR(S)/LIBRARIAN/PTI IN GCET IN HIGHER EDUCATION DEPARTMENT NOTIFIED VIDE NOTIFICATION NO. 11-PSC(DR-P) OF 2023 DATED 05.04.2023.

Syllabus for the Post of Assistant Professor Humanities

Unit-1

Management: Meaning, Characteristics, Process, Objectives and Functions of Management. Classical Theory of Management: Henry Fayol's Administrative Management Theory & Taylor's Scientific Management Theory. Elton Mayo's Neo-Classical theory of Human Relations Prospective and Modern Management Theory. MBO: Meaning, Steps and Benefits. Management by Exception.

Strategic Management: Concept, Process, Decision and Types; Strategic Analysis- External Analysis, PEST, Porter's Approach to Industry analysis, Internal Analysis- Resource Based Approach, Value Chain Analysis. Strategy Formulation- SWOT Analysis, Corporate Strategy- Growth Stability, Retrenchment, Integration and Diversification, Business Portfolio Analysis- BCG,GE Business Model, Ansoff's Product Market, Strategy Implementation- Challenges of Change, Developing Program me Mckinsey 7s Framework.

Unit 2:

Departmentation & Delegation of Authority: Meaning, Importance, Basis or Pattern of Departmentation. Delegation of Authority: Meaning, Characteristics, Importance, Process, Obstacles/ Barriers to effective delegation of authority. Line Organization, Line & Staff Organization, Functional Organization.

Human Resource Management: Concept, Perspectives, Influences and Recent Trends. Human Resource Planning. Recruitment and Selection, Induction, Training and Development. Job Analysis, Job Evaluation-Objectives, Principles & Methods of Job Evaluation. Concept of Wages, Characteristics of Good Wage System, Factors affecting Wages, Methods of Wage Payments.

Marketing: Concept, Orientation, Trends and Tasks, Customer Value and Satisfaction: Market Segmentation, Positioning and Targeting; Product and Pricing Decision- Product Mix, Product Life Cycle, New Product Development, Pricing-Types and Strategies; Place and Promotion Decision-Marketing Channels and Value Networks, VMS, IMC, Advertising and Sales Promotion.

Unit-3

Entrepreneurship: Definition, Difference between Intrapreneur & Entrepreneur, Types of

Entrepreneur, Qualities of a successful Entrepreneur. Functions of an Entrepreneur. Factors affecting Entrepreneurship. Schemes and policies for Entrepreneurship Development in India.

Entrepreneurship Development: Concept, Types, Theories and Process. Developing Entrepreneurship Competencies. Business Plan and Feasibility Analysis: Concept and Process of Technical, Market and Financial Analysis; Micro and Small Scale industries in India; Role of Government in Promoting SSI; Sickness in Small Industries- Reasons and Rehabilitation.

Women Entrepreneurs: Classification, Problems and Steps for Promoting Women Entrepreneurship.

Lean Startups, Business pitching, Starting a New project/ Venture: Scanning the Environment, Product Development and Selection, Project Report Preparation, Project Resourcing, Project Planning and Scheduling using Networking Techniques of PERT/CPM.

Legal Forms of Industrial Ownership: Sole Proprietorship, Partnership and Joint Stock Company (Features, Merits & Demerits)

Workers Participation in Management: Meaning, Objectives & Forms.

Trade Unions: Objectives, Functions, Present Position and Weaknesses.

Industrial Conflict: Sources and Managing Conflict.

Collective Bargaining: Meaning, Process, Essential conditions for Effective Bargaining.

Unit-4

Managerial Economics: Meaning and Scope of Managerial Economics.

Demand Analysis: Meaning of Demand and Law of Demand, Factors Affecting Demand, Elasticity of Demand(Price, Income and Cross Elasticity of Demand)

Cardinal Utility Analysis: Concept of law of Diminishing Marginal Utility: law of Equi marginal Utility, Ordinal utility analysis: Meaning and properties of Indifference curves and Utility Maximization(consumer equilibrium).

Revealed Preference Theory of Demand: Behaviouristic Approach to Demand Analysis. Preference Hypothesis and Strong Ordering. Deriving Demand Theorem from Revealed Preference Hypothesis.

Production Analysis: Meaning of Production Function, Isoquants(Meaning and Properties) Law of Variable Proportions, Law of Returns to Scale.

Cost Analysis: Concept of Fixed, Variable, Total, Average & Marginal Costs & their relationships in Short Run and Long Run.

Market structure: Perfect Competition and Monopoly (Price-Output Determination under Perfect Competition and Monopoly in short run and long run). Concept of

Monopolistic Competition and Oligopoly. Price - output Determination under Monopolistic Competition and Oligopoly.

International Economics: Theories of International Trade. Classical Theory and Modern Theory. Terms of Trade. Concept and Components of Balance of Trade and Balance of Payment, equilibrium and disequilibrium in BOP. Role of International Organizations, IMF, World Bank, World Trade Organizations in economic development of the country.

Unit-5

National Income: Concept, Methods of Measuring National Income, Difficulties in Measurement of National Income.

Inflation: Meaning, Types, Causes and Methods to Control Inflation.

Trade Cycle: Meaning , Phases and Causes of Trade Cycle.

Banking: Functions of Central Bank and Functions of Commercial Banks. Credit Creation.

Public Economics: Role of Government- Allocation, Distribution and Stabilization. Wagner's Theory of Public Expenditure. Taxation- types and Tax incidence. Theory of optimal taxation. Concept and Evolution of Fiscal-Federalism in India. Central – State financial relations- Vertical and Horizontal imbalances.

Indian Economy: Economic Growth since independence- Pattern and Structure. Agricultural Growth-Pattern and Structure, Major challenges and Policy response. Industrial Growth- Pattern and Structure. Industrial Policies of 1956 and 1991. Poverty, Inequality and Employment in India-extent, incidence and trends.

Monetary Economics: Money Supply and Components of Money Supply. Money Multiplier and its Determinants. Theories of Interest Rates- Classical, Loanable Fund and Neo-Keynesian.

Financial Institutions and Markets: Structure and Role of Financial System. Financial Markets-Functions and Instruments. Financial Intermediaries-Classification, Role and Functions. Working and Functioning of National Stock Exchange. Bombay Stock Exchange and Securities and Exchange Board of India.

Index Number: Meaning, Importance and Problems in Construction of Index Number.

Unit-6

Plant Location and Plant Layout: Selection Criteria. Factors Affecting Location Decision.

Definition, Importance, essentials and types of Layout. Factors Influencing Layout.

Production Planning and Control: Introduction, importance, Objectives and Key Functions.

Inventory Control: Types, Methods and Functions.

Total Quality Management: Meaning, Components, Evolution, Principles and Importance. Implementation of Total Quality Management. TQM in India. Concept of JUST-IN-TIME Production and Kanban System.

Financial Management: Concept and Functions; Capital Structure- Theories, Cost of Capital, Sources and Finance, Budgeting and Budgetary Control, Types and Process, Zero Base Budgeting; Leverages- Operating, Financial and Combined Leverages, EBIT – EPS Analysis, Financial Breakeven Point and Indifference level.

Decision Making: Meaning, Characteristics, Types, Stages and Techniques of Decision-Making.

Unit-7

Role of Language in Communication, Theory and Models of Communication, Purpose and Process of Communication. Barriers to Communication, Measures to Overcome the Barriers to Communication. Types of Communication Network, Formal and Informal Communication, Upward Communication, Downward Communication, Horizontal Communication and Diagonal Communication, Verbal Communication: Meaning and Importance. Non-Verbal Communication: Meaning and its Significance. Direct and Mediated Communication.

Communication skills & writing practice: Introduction, Elements of Business Communication, Media of Technology-Enabled Business Communication, Types of letter- Inquiry letter, Claims Letter, Adjustment and Sales Letter, Job Letter.

Approaches and Process of Listening. Types of listening: Techniques to improve listening ability. Speaking Skills: Advantages and Disadvantages. Skills of Effective Speaking: Tips for Writing Scripts and Speeches. Planning, Preparing and Delivering a Talk.

Presentation and Public Speaking: Monologue, Dialogue, Group Discussion, Interview and Telephonic Conversation. Phonetics and Phonology: Scope and Branches. Sound and Spelling Relationship in English. Organs of Speech; Speech Mechanism. IPA Symbols and their importance.

Unit-8

Organizational Behavior: Concept, Meaning, Nature, Scope and Models of Organizational Behavior, Individual Differences, Meaning of Personality, Determinants of Personality and Personality Development. Components and Functions of Attitudes, Concept of Learning, Theories of Learning. Characteristics and Steps of Organization Development. Organizational Change: Forces of Change and Managing Change.

Leadership: Meaning, Approaches, Qualities and leadership Styles.

Motivation: Concept, Importance and Theories.

Organizational Climate and Organizational Culture.

Unit-9

Research Methodology: Types of Research, Research Methods and Methodology, Defining a Research Problem. Research Design: Need for Research Design, Basic Principles of experimental designs, Sampling Design, Steps in Sampling Design, Types of Sampling Design, Measurement and Scaling Techniques; Measurement in Research, Measurement Scales, Sources in Error, Techniques of Developing Measurement Tools, Scaling, Meaning of Scale, Scale Construction Techniques. Methods of Data Collection and Analysis, Selection of appropriate method, Data Processing , Elements of Analysis, Statistics in Research, Measures of Dispersion, Measures of Skewness, Regression Analysis, Correlation. Techniques of Hypotheses: Hypotheses, Parametric or Standard Tests: Basic concepts, Tests for Hypotheses I and II, Important parameters limitations of the tests of Hypotheses, Chi-square Test, Comparing Variance, as a nonparametric Test, Conversion of Chi to Phi, Caution in using Chi-square test.

Unit-10

Value Education: Need, Basic Guidelines Content, and Process. Meaning of Basic Aspiration. Development of Human Consciousness. Role of Education-Sanskar Enabling the Transformation to Human Consciousness. Meaning of Happiness and Prosperity. Harmony in the Self. The Needs of Self and Body. Activities of Self. Sources of Imagination. Programme for Self-regulation and Health. Harmony in the Family and Society. Feelings in Relationship. Meaning of Trust(foundation value), Respect, Affection, Care, Guidance, Reverence, Glory, Gratitude and Love(complete value). Harmony in Human-Human Relationship; Harmony in Nature and Existence; Existence as a Co-existence. Implication of the Holistic understanding of Harmony on Professional Ethics; Competence in Professional Ethics.

CHEMISTRY

Atomic Structure :

Heisenberg's uncertainty principle Schrodinger wave equation (time independent); Interpretation of wave function, particle in one- dimensional box, quantum numbers, hydrogen atom wave functions; Shapes of s, p and d orbitals.

Chemical bonding :

Ionic bond, characteristics of ionic compounds, lattice energy, Born-Haber cycle; covalent bond and its general characteristics, polarities of bonds in molecules and their dipole moments; Valence bond theory, concept of resonance and resonance energy; Molecular orbital theory (LCAO method); bonding H2 +, H2 He_2 + to Ne_2, NO, CO, HF, CN^-, Comparison of valence bond and molecular orbital theories, bond order, bond strength and bond length.

3. **Solid State :**

Crystal systems; Designation of crystal faces, lattice structures and unit cell; Bragg's law; X-ray diffraction by crystals; Close packing, radius ratio rules, calculation of some limiting radius ratio values; Structures of NaCl, ZnS, CsCl, CaF_2; Stoichiometric and nonstoichiometric defects, impurity defects, semi-conductors.

4. **The Gaseous State and Transport Phenomenon :**

Equation of state for real gases, intermolecular interactions, and critical phenomena and liquefaction of gases; Maxwell's distribution of speeds, intermolecular collisions, collisions on the wall and effusion; Thermal conductivity and viscosity of ideal gases.

5. **Liquid State :**

Kelvin equation; Surface tension and surface energy, wetting and contact angle, interfacial tension and capillary action.

6. **Thermodynamics :**

Work, heat and internal energy; first law of thermodynamics.

Second law of thermodynamics; entropy as a state function, entropy changes in various processes, entropy-reversibility and irreversibility, Free energy functions; Thermodynamic equation of state; Maxwell relations; Temperature, volume and pressure dependence of U, H, A, G, Cp and Cv, α and β ; J-T effect and inversion temperature; criteria for equilibrium, relation between equilibrium constant and thermodynamic quantities; Nernst heat theorem, introductory idea of third law of thermodynamics.

7. **Phase Equilibria and Solutions :**

Clausius-Clapeyron equation; phase diagram for a pure substance; phase equilibria in binary systems, partially miscible liquids—upper and lower critical solution temperatures, partial molar quantities, their significance and determination; excess thermodynamic functions and their determination.

8. **Electrochemistry :**

Debye-Huckel theory of strong electrolytes and Debye-Huckel limiting Law for various equilibrium and transport properties.

Galvanic cells, concentration cells; electrochemical series, measurement of e.m.f. of

cells and its applications fuel cells and batteries.
Processes at electrodes: double layer at the interface; rate of charge transfer, current density; overpotential; electroanalytical techniques : amperometry, ion selective electrodes and their use.

9. **Chemical Kinetics:**
Differential and integral rate equations for zeroth, first, second and fractional order reactions; Rate equations involving reverse, parallel, consecutive and chain reactions. Branching chain and explosions; effect of temperature and pressure on rate constant. Study of fast reactions by stop-flow and relaxation methods. Collisions and transition state theories.

10. **Photochemistry:**
Absorption of light; decay of excited state by different routes; photochemical reactions between hydrogen and halogens and their quantum yields.

11. **Surface Phenomena and Catalysis:**
Adsorption from gases and solutions on solid adsorbents; Langmuir and B.E.T. adsorption isotherms; determination of surface area, characteristics and mechanism of reaction on heterogeneous catalysts.

12. **Bio-inorganic Chemistry:**
Metal ions in biological systems and their role in ion-transport across the membranes (molecular mechanism), oxygen-uptake proteins, cytochromes and ferrodoxins.

13. **Coordination Chemistry :**
(i) Bonding in transition of metal complexes. Valence bond theory, crystal field theory and its modifications; applications of theories in the explanation of magnetism and elctronic spectra of metal complexes.
(ii) Isomerism in coordination compounds; IUPAC nomenclature of coordination compounds; stereochemistry of complexes with 4 and 6 coordination numbers; chelate effect and polynuclear complexes; trans effect and its theories; kinetics of substitution reactions in square-planar complexes; thermodynamic and kinetic stability of complexes.
(iii) EAN rule, Synthesis structure and reactivity of metal carbonyls; carboxylate anions, carbonyl hydrides and metal nitrosyl compounds.
(iv) Complexes with aromatic systems, synthesis, structure and bonding in metal olefin complexes, alkyne complexes and cyclopentadienyl complexes; coordinative unsaturation, oxidative addition reactions, insertion reactions, fluxional molecules and their characterization; Compounds with metal—metal bonds and metal atom clusters.

14. **Main Group Chemistry:**
Boranes, borazines, phosphazenes and cyclic phosphazene, silicates and silicones, Interhalogen compounds; Sulphur—nitrogen compounds, noble gas compounds.

15. **General Chemistry of 'f' Block Element:**
Lanthanides and actinides: separation, oxidation states, magnetic and spectral properties; lanthanide contraction.

1. **Delocalised Covalent Bonding :**
Aromaticity, anti-aromaticity; annulenes, azulenes, tropolones, fulvenes, sydnones.

2. (i) **Reaction mechanisms :** General methods (both kinetic and non-kinetic) of study of mechanisms of organic reactions : isotopes, mathod cross-over experiment, intermediate trapping, stereochemistry, energy of activation; thermodynamic control and kinetic control of reactions.
(i) **Reactive intermediates** : Generation, geometry, stability and reactions of carboniumions and carbanions, free radicals, carbenes, benzynes and nitrenes.

(iii) **Substitution reactions** :—S_N 1, S_N 2, and S_N i, mechanisms ; neighbouring group participation; electrophilic and nucleophilic reactions of aromatic compounds including heterocyclic compounds— pyrrole, furan, thiophene and indole.

(iv) **Elimination reactions** :—E1, E2 and E1cb mechanisms; orientation in E2 reactions— Saytzeff and Hoffmann; pyrolytic *syn* elimination—acetate pyrolysis, Chugaev and Cope eliminations.

(v) **Addition reactions** :—Electrophilic addition to C=C and C≡C; nucleophilic addition to C=O, C≡N, conjugated olefins and carbonyls.

(vi) **Reactions and Rearrangements** :—(a) Pinacol-pinacolone, Hoffmann, Beckmann, Baeyer-Villiger, Favorskii, Fries, Claisen, Cope, Stevens and Wagner—Meerwein rearrangements.

(b) Aldol condensation, Claisen condensation, Dieckmann, Perkin, Knoevenagel, Witting, Clemmensen, Wolff-Kishner, Cannizzaro and von Richter reactions; Stobbe, benzoin and acyloin condensations; Fischer indole synthesis, Skraup synthesis, Bischler-Napieralski, Sandmeyer, Reimer-Tiemann and Reformatsky reactions.

3. **Pericyclic reactions** :—Classification and examples; Woodward-Hoffmann rules—electrocyclic reactions, cycloaddition reactions [2+2 and 4+2] and sigmatropic shifts [1, 3; 3, 3 and 1, 5], FMO approach.

4. (i) **Preparation and Properties of Polymers:** Organic polymerspolyethylene, polystyrene, polyvinyl chloride, teflon, nylon, terylene, synthetic and natural rubber.

(ii) Biopolymers: Structure of proteins, DNA and RNA.

5. **Synthetic Uses of Reagents:**

OsO_4, HIO_4, CrO_3, $Pb(OAc)_4$, SeO_2, NBS, B_2H_6, Na-Liquid NH_3, $LiAlH_4$, $NaBH_4$, n-BuLi, MCPBA.

6. **Photochemistry** :—Photochemical reactions of simple organic compounds, excited and ground states, singlet and triplet states, Norrish-Type I and Type II reactions.

7. **Spectroscopy:**

Principle and applications in structure elucidation :

(i) **Rotational**—Diatomic molecules; isotopic substitution and rotational constants.

(ii) **Vibrational**—Diatomic molecules, linear triatomic molecules, specific frequencies of functional groups in polyatomic molecules.

(iii) **Electronic**—Singlet and triplet states, $n \rightarrow \pi^*$ and $\pi \rightarrow \pi^*$ transitions; application to conjugated double bonds and conjugated carbonyls Woodward-Fieser rules; Charge transfer spectra.

(iv) **Nuclear Magnetic Resonance (^{1}HNMR)** : Basic principle; chemical shift and spin-spin interaction and coupling constants.

(v) **Mass Spectrometry** :—Parent peak, base peak, metastable peak, McLafferty rearrangement.

APPLIED SCIENCE AND HUMANITIES

PHYSICS

1. (a) Mechanics of Particles :

Laws of motion; conservation of energy and momentum, applications to rotating frames, centripetal and Coriolis accelerations; Motion under a central force; Conservation of angular momentum, Kepler's laws; Fields and potentials; Gravitational field and potential due to spherical bodies, Gauss and Poisson equations, gravitational self-energy; Two-body problem; Reduced mass; Rutherford scattering; Centre of mass and laboratory reference frames.

(b) Mechanics of Rigid Bodies :

System of particles; Centre of mass, angular momentum, equations of motion; Conservation theorems for energy, momentum and angular momentum; Elastic and inelastic collisions; Rigid Body, Degrees of freedom, Euler's theorem, angular velocity, angular momentum, moments of inertia, theorems of parallel and perpendicular axes, equation of motion for rotation; Molecular rotations (as rigid bodies); Di and tri-atomic molecules; Precessional motion; top, gyroscope.

(c) Mechanics of Continuous Media :

Elasticity, Hooke's law and elastic constants of isotropic solids and their inter-relation; Streamline (Laminar) flow, viscosity, Poiseuille's equation, Bernoulli's equation, Stokes' law and applications.

(d) Special Relativity :

Michelson-Morely experiment and its implications; Lorentz transformations length contraction, time dilation, addition of relativistic velocities, aberration and Doppler effect, mass-energy relation, simple applications to a decay process. Four dimensional momentum vector; Covariance of equations of physics.

2. Waves and Optics :

(a) Waves :

Simple harmonic motion, damped oscillation, forced oscillation and resonance; Beats; Stationary waves in a string; Pulses and wave packets; Phase and group velocities; Reflection and refraction from Huygens' principle.

(b) Geometrial Optics :

Laws of reflection and refraction from Fermat's principle; Matrix method in paraxial optic-thin lens formula, nodal planes, system of two thin lenses, chromatic and spherical aberrations.

(c) Interference :

Interference of light -Young's experiment, Newton's rings, interference by thin films, Michelson interferometer; Multiple beam interference and Fabry Perot interferometer.

(d) Diffraction :

Fraunhofer diffraction - single slit, double slit, diffraction grating, resolving power; Diffraction by a circular aperture and the Airy pattern; Fresnel diffraction: half-period zones and zone plates, circular aperture.

(e) Polarisation and Modern Optics :

Production and detection of linearly and circularly polarized light; Double refraction, quarter wave plate; Optical activity; Principles of fibre optics, attenuation; Pulse dispersion in step index and parabolic index fibres; Material dispersion, single mode fibers; Lasers-Einstein A and B coefficients. Ruby and He-Ne lasers. Characteristics of laser light-spatial and temporal coherence; Focusing of laser beams. Three-level scheme for laser operation; Holography and simple applications.

3. Electricity and Magnetism :

(a) Electrostatics and Magnetostatics :

Laplace and Poisson equations in electrostatics and their applications; Energy of a system of charges, multipole expansion of scalar potential; Method of images and its applications. Potential and field due to a dipole, force and torque on a dipole in an external field; Dielectrics, polarisation. Solutions to boundary-value problems-conducting and dielectric spheres in a

uniform electric field; Magnetic shell, uniformly magnetised sphere; Ferromagnetic materials, hysteresis, energy loss.

(b) Current Electricity :

Kirchhoff's laws and their applications. Biot-Savart law, Ampere's law, Faraday's law, Lenz' law. Self-and mutual-inductances; Mean and rms values in AC circuits; DC and AC circuits with R, L and C components; Series and parallel resonance; Quality factor; Principle of transformer.

4. Electromagnetic Waves and Blackbody Radiation :

Displacement current and Maxwell's equations; Wave equations in vacuum, Poynting theorem; Vector and scalar potentials; Electromagnetic field tensor, covariance of Maxwell's equations; Wave equations in isotropic dielectrics, reflection and refraction at the boundary of two dielectrics; Fresnel's relations; Total internal reflection; Normal and anomalous dispersion; Rayleigh scattering. Blackbody radiation and Planck 's radiation law- Stefan-Boltzmann law, Wien's displacement law and Rayleigh-Jeans law.

5. Thermal and Statistical Physics :

(a) Thermodynamics :

Laws of thermodynamics, reversible and irreversible processes, entropy; Isothermal, adiabatic, isobaric, isochoric processes and entropy changes; Otto and Diesel engines, Gibbs' phase rule and chemical potential; Van der Waals equation of state of a real gas, critical constants; Maxwell-Boltzmann distribution of molecular velocities, transport phenomena, equipartition and virial theorems; Dulong-Petit, Einstein, and Debye's theories of specific heat of solids; Maxwell relations and application; Clausius-Clapeyron equation. Adiabatic demagnetisation, Joule-Kelvin effect and liquefaction of gases.

(b) Statistical Physics :

Macro and micro states, statistical distributions, Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac Distributions, applications to specific heat of gases and blackbody radiation; Concept of negative temperatures.

1. Quantum Mechanics :

Wave-particle duality; Schroedinger equation and expectation values; Uncertainty principle; Solutions of the one-dimensional Schroedinger equation for free particle (Gaussian wave-packet), particle in a box, particle in a finite well, linear harmonic oscillator; Reflection and transmission by a step potential and by a rectangular barrier; Particle in a three dimensional box, density of states, free electron theory of metals; Angular momentum; Hydrogen atom; Spin half particles, properties of Pauli spin matrices.

2. Atomic and Molecular Physics :

Stern-Gerlach experiment, electron spin, fine structure of hydrogen atom; L-S coupling, J-J coupling; Spectroscopic notation of atomic states; Zeeman effect; Franck-Condon principle and applications; Elementary theory of rotational, vibrational and electronic spectra of diatomic molecules; Raman effect and molecular structure; Laser Raman spectroscopy; Importance of neutral hydrogen atom, molecular hydrogen and molecular hydrogen ion in astronomy. Fluorescence and Phosphorescence; Elementary theory and applications of NMR and EPR; Elementary ideas about Lamb shift and its significance.

3. Nuclear and Particle Physics :

Basic nuclear properties-size, binding energy, angular momentum, parity, magnetic moment; Semi-empirical mass formula and applications. Mass parabolas; Ground state of a deuteron, magnetic moment and non-central forces; Meson theory of nuclear forces; Salient features of nuclear forces; Shell model of the nucleus - success and limitations; Violation of parity in beta decay; Gamma decay and internal conversion; Elementary ideas about Mossbauer spectroscopy; Q-value of nuclear reactions; Nuclear fission and fusion, energy production in stars. Nuclear reactors.

Classification of elementary particles and their interactions; Conservation laws; Quark structure of hadrons : Field quanta of electroweak and strong interactions; Elementary ideas about unification of forces; Physics of neutrinos.

4. **Solid State Physics, Devices and Electronics :**

Crystalline and amorphous structure of matter; Different crystal systems, space groups; Methods of determination of crystal structure; X-ray diffraction, scanning and transmission electron microscopies; Band theory of solids—conductors, insulators and semi-conductors; Thermal properties of solids, specific heat, Debye theory; Magnetism: dia, para and ferromagnetism; Elements of super-conductivity, Meissner effect, Josephson junctions and applications; Elementary ideas about high temperature super-conductivity.

Intrinsic and extrinsic semi-conductors- p-n-p and n-p-n transistors; Amplifiers and oscillators. Op-amps; FET, JFET and MOSFET; Digital electronics-Boolean identities, De Morgan's laws, Logic gates and truth tables. Simple logic circuits; Thermistors, solar cells; Fundamentals of microprocessors and digital computers.

SYLLABUS FOR THE POST OF ASSISTANT PROFESSOR IN MATHEMATICS

1. REAL ANALYSIS

Elementary set theory, finite, countable and uncountable sets, Real number system as a complete ordered field, Archimedean property, supremum, infimum, Sequences and series, convergence, limsup, liminf, Bolzano-Weierstrass theorem, Heine-Borel theorem, continuity, uniform continuity, differentiability, mean value theorem, Sequences and series of functions, uniform convergence, Riemann sums and Riemann integral, Improper Integrals, Monotonic functions, types of discontinuity, functions of bounded variations, Lebesgue measure, Lebesgue integral, Functions of several variables, directional derivative, partial derivative, total derivative, Mean value theorem for differentiable functions, inverse and implicit function theorems.

2. COMPLEX ANALYSIS

Algebra of Complex numbers, Complex plane, Functions of a Complex variable, Continuity, Differentiability, CR-equations, Analytic Functions, Necessary and sufficient condition for analyticity, Harmonic functions, Harmonic Conjugate, Contour integration, Cauchy integral theorem, Cauchy Integral Formula, Liouville's Theorem, Maximum Modulus Principle, Fundamental Theorem of Algebra, Morera's Theorem, Schwarz Lemma, Open mapping theorem, Taylor series expansion, Laurent series expansion, Elementary Linear Transformations, Mobius Transformation, Conformal mapping, singularities and types, Riemann's theorem on removable singularities, Cauchy Residue theorem, integrals of rational and trigonometric functions by residue theorem.

3. TOPOLOGY

Metric spaces: definition and examples, open and closed sets, compactness in metric spaces, continuity, uniform continuity, complete metric spaces, Topological spaces, open sets, closed sets, closure, interior, boundary of a set, neighbourhood system, method of defining a topology in terms of Kuratowski closure operator, Hausdorff criterion , accumulation point, bases and subbases, relative topology, continuous maps, open maps, closed maps, and their important characterizations, homeomorphisms, Product topology and its properties, weak topology induced by family of maps, evaluation maps, quotient topology and its properties, decomposition spaces, examples of quotient spaces like cylinder, circle, torus, Mobius band, Separation Axioms, Compactness and connectedness in topological spaces, Tychnoff's theorem.

4. FUNCTIONAL ANALYSIS

Contraction mapping, Banach Contraction principle, Application to differential and integral equations, completion of a metric space, Baire's category theorem and its application, Arzela-Ascoli theorem, Normed linear spaces, Banach spaces, Finite dimensional normed linear spaces, equivalent norms, Compactness and finite dimension, Quotient spaces, F-Riesz lemma, Bounded and continuous linear operators and linear functionals, dual spaces, Hahn-Banach theorem and its application, uniform boundedness principles, open mapping theorem, Bounded inverse theorem, closed graph theorem, Inner product spaces, Cauchy-Schwarz inequality, Inner Product Spaces, Hilbert spaces, orthogonal complements and direct sums, orthonormal sets, projection theorem, Riesz Representation theorem, bounded operators and adjoints, normal, unitary and self- adjoint operators.

5. ABSTACT ALGEBRA

Groups, subgroups, normal subgroups, quotient groups, homomorphism, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems, Rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain, Polynomial rings and irreducibility criteria, Fields, finite fields, field extensions, Galois Theory.

6. LINEAR ALGEBRA

Vector spaces, subspaces, linear dependence and independence, linear span, basis, dimension of vector spaces, linear transformations, algebra of linear transformations, Algebra of matrices, rank and determinant of matrices, linear equations and solutions, Eigen values and eigen vectors, Cayley-Hamilton theorem, Matrix representation of linear transformations, Change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms, Quadratic forms, reduction and classification of quadratic forms.

7. DIFFERENTIAL EQUATIONS

Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs, linear dependence and independence of solution, Wronskian's method of reduction of order, variation of parameters technique, power series solution about an ordinary point, solution of Legendre equation, Legendre polynomial, solution of Euler's equation, solution of Bessel's equation.

Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs, Classification of second order PDEs, General solution of higher order PDEs with constant coefficients, Method of separation of variables for Laplace, Heat and Wave equations.

8. NUMBER THEORY

Divisibility, division algorithm, greatest integer function, Primes, Euclid's Theorem, Prime Number Theorem, the greatest common divisor, the least common multiple, The Fundamental Theorem of Arithmetic, Euclid's first theorem, Linear Diophantine equation, Euclid's second theorem Congruences, residue classes, complete residue systems, reduced residue systems, Linear congruences in one variable, Chinese Remainder Theorem, Wilson's Theorem, Fermat's Little Theorem, Euler's Theorem, Arithmetic function, multiplicative functions, The Mobius function, Mobius inversion formula, The Euler phi function, Carmichael conjecture, The number-of-divisors and sum-of-divisors functions, Perfect numbers, characterization of even perfect numbers, Quadratic residues ,The Legendre symbol, Euler's Criterion, Gauss' Lemma, The law of quadratic reciprocity, The order of an integer, Primitive roots, The Primitive Root Theorem.

9. NUMERICAL ANALYSIS AND TRANSFORM CALCULUS

Numerical solutions of algebraic equations, Method of iteration and Newton-Raphson method, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, Finite differences, Lagrange, Hermite and Spline interpolation, Numerical differentiation and integration, Numerical solutions of ODEs using Picard, Taylor, Euler, modified Euler and Runge-Kutta methods.

Laplace Transform, Linear property, change of scale property, first shifting property, second shifting property, Multiplication by t property, division by t property, convolution property, Laplace transform of periodic functions, Laplace transform of derivatives, inverse Laplace transform by different methods, evaluation of integrals by Laplace transform, solving differential equations of higher order by Laplace Transform.

Fourier Integrals, Fourier transforms, Fourier integral theorem, Fourier sine and cosine integrals, and their inverses, properties of Fourier transforms, application of Fourier transform to solve integral equations, Parseval's identity for Fourier transforms.

10. DISCRETE MATHEMATICS

Introduction to logic, Methods of Proof: Rules of Inference, Valid Arguments, Rules of inference for quantified statements, Methods of proving theorems: Direct proofs, Indirect proofs, Proof by contradiction, Proof by cases, Proofs of equivalence.

Basic counting principles, the product rule and the sum rule, the inclusion–exclusion principle, the Pigeonhole Principle.

Graphs, types of graphs, basic terminology, Subgraphs, Representing graphs as incidence matrix and adjacency matrix, Graph isomorphism, Walk, Path and cycle, connectedness in simple graphs, weighted graphs, Dijkstra's algorithm to find the shortest distance paths in graphs, Hamiltonian

and Eulerian paths and circuits, Eulerian graphs, Hamiltonian graphs, Konigsberg bridge problem, Chinese postman problem, Travelling salesperson problem, Planar graph and Euler's formula. Trees, rooted trees, path lengths in rooted trees, spanning trees and cut sets.

Syllabus for the Posts of Assistant Professor BIO-MEDICAL Engineering

Module 1: Electric circuit and Networks

Ideal voltage and current sources, dependent sources, R, L, C and M elements, KCL, KVL, Node and Mesh analysis, Network Theorems, Thevenin's, Norton's, Millman's, superposition and maximum power transfer theorem, Sinusoidal steady state analysis: phasors, complex power and power factor in ac circuits, maximum power transfer; Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform. Linear 2-port network parameters, balanced three phase circuits, star-delta transformation, transient response of DC and AC networks, Resonance, ideal current and voltage sources, Source conversions, Circuit solution using network theorems, two-port networks, network parameters: driving point and transfer functions, Solutions of network equations using Laplace transform.
Filters - Low pass, high pass and band-pass filters.

Module 2: Control System and Signal& Systems:

Open loop and closed loop system – Transfer function, force-voltage & force-current analogy, block diagrams, signal flow graphs – Mason's gain formula – characteristic equation, time domain analysis – transient & steady state responses – time domain specifications & steady state error. Concept of stability – Routh's stability criterion – Root locus – effect of addition of poles and zeros. Frequency domain analysis – Nyquist & Bode plots, gain margins and phase margin, lag, lead and lag-lead compensators and their design using Bode plot, State space analysis of system – state space models, state transition matrix, relationship between state equations and transfer function, controllability and observability. Nonlinear system – characteristics, types of non-linearities, describing functions, analysis – concept, singular points – focus, Centre, node and saddle points – limit cycle. Types of
Continuous-time Signals: Representation of Continuous time signal and shifting and scaling Properties, Fourier series and Fourier transform, sampling theorem and applications.
Discrete-time Signals: Representation and Properties, DTFT, DFT, z-transform, discrete-time processing of continuous-time signals, Laplace transform.
LTI systems: Definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.

Module 3: Electronics Devices & Analog Circuits

Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors. Carrier Transport: Diffusion current, drift current, mobility and resistivity, generation and recombination of carriers.
PN junction, Zener diode, LEDs, Diode Circuits: clipping, clamping and rectifiers.BJT, JFET, MOSFET. MOSFET- structure, types, different modes, characteristics and equations.
BJT and MOSFET Amplifiers: Biasing, ac coupling, small signal analysis, frequency response BJTs, FET, MOSFETs. Biasing and bias stability of transistor and FET amplifiers. Single-and multi-stage Amplifiers, feedback Amplifiers-Topologies and analysis, Oscillators-Types and analysis and power amplifiers. Frequency response of amplifiers, Differential amplifiers.

Op-amp Circuits: Simple op-amp circuits-Amplifiers, summers, differentiate, integrator, active filters. Sinusoidal oscillators; waveform generators criterion for oscillation; Schmitt triggers and oscillators, Comparators, Precision rectifiers, wave-shaping circuits, 555 Timers IC and its applications.

Module 4: Digital Electronics and Microprocessor

Number Representations: Binary, integer and floating-point- numbers, Number systems: Binary, decimal, octal, hexadecimal, BCD number systems and their conversions, Binary and hexadecimal addition, subtraction.
Combinational circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates, arithmetic circuits, code converters, multiplexers, decoders.
Sequential Circuits: Latches and flip-flops, Synchronous and asynchronous counters, shift-registers, finite state machines, propagation delay, setup and hold time, critical path delay.
Data Converters: Sample and hold circuits, ADCs and DACs.
Semiconductor Memories: ROM, SRAM, DRAM.
Microprocessor(8085): Architecture, addressing modes, instruction set, interrupts, Programming, Memory and I/O interfacing.

Module 5: Sensors and Measurements:

Sensors - Resistive, capacitive, inductive, piezoelectric, Hall effect, electro chemical, optical fibre sensor, types of optical fibre sensors and it's advantages, signal conditioning circuits, signal amplification, frequency response, filtering , pre-amplifiers, AC coupled amplifiers, chopper input dc amplifier, chopper stabilized dc amplifier, dc bridge amplifier, instrument amplifier, sources of noise in low level measurements: Electrostatic and electromagnetic coupling to ac signals, common impedance coupling, application of ND-YAG, Helium neon CO2 LASER in sensing and therapy.
Measurements: Units and standards of Measurements, systematic and random errors in measurement, expression of uncertainty -accuracy and precision index, propagation of errors.

Module 6: Bioinstrumentation:

Origin of biopotentials and their measurement techniques: Electrical activity associated with contraction in a muscle, characteristics of bio electric signal and their measurement techniques - ECG, EEG, EMG, PCG, EOG, GSR, skin contact impedance, motion artefacts, Electrodes for ECG, EEG & EMG, ECG leads, Effects of artefacts on ECG recording, microprocessor based ECG machines, Vector cardio graph, Microphones for phonocardiography, cardiac arrhythmias, block diagram of basic arrhythmia monitoring system, QRS detection, morphology characterization, Block diagram description of electroencephalograph: electrode montage selector, preamplifier, sensitivity control, noise, writing part, paper drive, channels, frequency analysis and amplitude analysis, compressed spectral arrays for EEG signals. Biomedical recoders: Apexcardiograph, Ballistocardiograph, electro-oculograph. Biofeedback instrumentation.
Transducer: Classification, Performance characteristics: potentiometric, variable capacitance, variable inductance, piezoelectric. Microelectrodes: Glass Microcapillary Electrodes, Metal Microelectrodes. Principles of measuring blood pressure, direct and indirect methods of monitoring blood pressure measurements, body temperature, respiratory measurements and cardiac output measurement, cardiac monitor, cardiac output

using digital memory, block diagram of basic arrhythmias monitoring system: signal conditioning, noise detection, QRS detection, morphological characterization. Timing classification, atrial fibrillation detection.

Operating principle of medical equipment-Sphygmomanometer, ventilator, cardiac pacemaker, defibrillator, pulse oximeter, Electrical Isolation (optical and electrical) and Safety of Biomedical Instruments.

Module 7: Human Anatomy and Physiology:

Basics of cell: Cell definition, characteristics of cell, types of cells, cell structure, function of cells, types of tissues and organ systems; Homeostasis; Basics of organ systems - musculoskeletal, respiratory, circulatory, excretory, endocrine, nervous, gastro-intestinal and reproductive.

Module 8: Medical Imaging Systems:

Basic physics, Instrumentation and image formation techniques in medical imaging modalities such as X-Ray, Computed Tomography, Single Photon Emission Computed Tomography, Positron Emission Tomography, Magnetic Resonance Imaging: Principle of nuclear magnetic resonance (NMR) imaging system, Free induction decay in NMR, basics of NMR components, biological effects of NMR imaging, Ultrasound, physics of ultrasonic waves, basic pulse echo apparatus, application of ultrasound in medical, ASCAN Application of A-SCAN.

Module 9: Biomechanics and Biomaterials:

Kinematics of muscle and joints - Free-body diagrams and equilibrium, forces and stresses in joints, biomechanical analysis of joints, Gait cycle, Gait analysis, types of Gait analysis; Hard Tissues - Definition of Stress and Strain, Deformation Mechanics, Structure and mechanical properties of bone - cortical and cancellous bones; Soft Tissues - Structure, functions, material properties, viscoelastic properties, Maxwell & Voight models, Biofluids mechanics -Flow properties of blood in the intact human cardiovascular system
Basic properties of biomaterials - Metallic, Ceramic, Polymeric and Composite; Fundamental characteristics of implants - Biocompatibility, bioactivity, biodegradability; Basics of drug delivery, Biomaterial characterization techniques - X-Ray diffraction, Electron Microscopy, Transmission Electron Microscopy, Scanning electron microscopy.

Module 10: Tissue engineering:

Structural organization of tissues, Epithelial cell, Types of Epithelial cell based on shape and arrangement, Epithelial cell based on specialized functions, what conditions effect epithelial tissues, epithelial connective, vascularity and angiogenesis, Basic wound healing, types of wounds and types of wound healing, factors affecting wound healing, cell migration, cell signaling, cell adhesion, Extra cellular matrix, basics of cell culture, cell expansion, cell transfer, cell storage and characterization.

1. **Engineering Mechanics, Strength of Materials and Structural Analysis.**

1.1 **Engineering Mechanics :**

Units and Dimensions. SI Units, Vectors, Concept of Force, Concept of particle and rigid body. Concurrent, Non- Concurrent and parallel forces in a plane, moment of force free body diagram, conditions of equilibrium, Principle of virtual work, equivalent force system.

First and Second Moment of area. Mass moment of Inertia.

Static Friction. Kinematics and Kinetics:

Kinematics in cartesian Co-ordinates, motion under uniform and non-uniform acceleration, motion under gravity. Kinetics of particle : Momentum and Energy principles, collision of elastic bodies, rotation of rigid bodies.

1.2 **Strength of Materials :**

Simple Stress and Strain, Elastic constants, axially loaded compression members, Shear force and bending moment, theory of simple bending, Shear Stress distribution across cross sections, Beams of uniform strength.

Deflection of beams: Mecaulay's method, Mohr's Moment area method, Conjugate beam method, unit load method. Torsion of Shafts, Elastic stability of columns, Euler's, Rankine's and Secant formulae.

1.3 **Structural Analysis :**

Castiglianio's theorems I and II, unit load method, of consistent deformation applied to beams and pin jointed trusses. Slope-deflection, moment distribution.

Rolling loads and Influences lines . Influences lines for Shear Force and Bending moment at a section of a beam. Criteria for maximum shear force and bending Moment in beams traversed by a system of moving loads. Influences lines for simply supported plane pin jointed trusses.

Arches : Three hinged, two hinged and fixed arches, rib shortening and temperature effects.

Matrix mehods of analysis : Force method and displacement method of analysis of indeterminate beams and rigid frames.

Plastic Analysis of beams and frames : Theory of plastic bending, plastic analysis, statical method, Mechanism method.

Unsymmetrical bending : Moment of inertia, product of inertia, position of Neutral Axis and Principal axes, calculation of bending stresses.

2. **Design of Structures : Steel, Concrete and Masonry Structures.**

2.1 **Structural Steel Design :**

Structural steel : Factors of safety and load factors. Riveted, bolted and welded joints and connections. Design of tension and compression members, beams of built up section, riveted and welded plate girders, gantry girders, stancheons with battens and lacings.

2.2 **Design of Concrete and Masonry Structures :**

Concept of mix design. Reinforced Concrete : Working Stress and Limit State method of design— Recommendations of I. S. codes. Design of one way and two way slabs, stair-case slabs, simple and continuous beams of rectangular, T and L sections. Compression members under direct load with or without eccentricity.

Cantilever and Counter fort type retaining walls.

Water tanks : Design requirements for Rectangular and circular tanks resting on ground.

Prestressed Concrete : Methods and systems of prestressing, anchorages, Analysis and design of sections for flexure based on working stress, loss of prestress.

Design of brick masonry as per I. S. Codes

3. **Fluid Mechanics, Open Channel Flow and Hydraulic Machines :**

3.1 **Fluid Mechanics :**

Fluid properties and their role in fluid motion, fluid statics including forces acting on plane and curve surfaces.

Kinematics and Dynamics of Fluid flow : Velocity and accelerations, stream lines, equation of continuity, irrotational and rotational flow, velocity potential and stream functions.

Continuity, momentum, energy equation, Navier Stokes equation, Euler's equation of motion, application to fluid flow problems, pipe flow, sluice gates, weirs.

3.2 Dimensional Analysis and Similitude:

Buckingham's Pi-theorem, dimensionless parameters.

3.3 Laminar Flow :

Laminar flow between parallel, stationary and moving plates, flow through tube.

3.4 Boundary layer :

Laminar and turbulent boundary layer on a flat plate, laminar sub-layer, smooth and rough boundaries, drag and lift.

Turbulent flow through pipes : Characteristics of turbulent flow, velocity distribution and variation of pipe friction factor, hydraulic grade line and total energy line.

3.5 Open Channel Flow :

Uniform and non-uniform flows, momentum and energy correction factors, specific energy and specific force, critical depth, rapidly varied flow, hydraulic jump, gradually varied flow, classification of surface profiles, control section, step method of integration of varied flow equation.

3.6 Hydraulic Machines and Hydropower :

Hydraulic turbines, types classification, Choice of turbines performance parameters, controls, characteristics, specific speed.

Principles of hydropower development.

4. Geotechnical Engineering :

Soil Type and Structure—gradation and particle size distribution—consistency limits.

Water in soil—capillary and structural—effective stress and pore water pressure—permeability concept—filed and laboratory determination of permeability—Seepage pressure—quick sand conditions—Shear strength determination— Mohr Coulomb concept.

Compaction of soil—Laboratory and filed test.

Compressibility and consolidation concept— consolidation theory—consolidation settlement analysis.

Earth pressure theory and analysis for retaining walls, Application for sheet piles and Braced excavation.

Bearing capacity of soil—approaches for analysis- Filed tests—settlement analysis—stability of slope of earth walk. Subsuface exploration of soils—methods

Foundation—Type and selection criteria for foundation of structures—Design criteria for foundation—Analysis of distribution of stress for footings and pile—pile group action—pile load test.

Ground improvement techniques.

1. Construction Technology, Equipment, Planning and Management

1.1 Construction Technology

Engineering Materials :

Physical properties of construction materials with respect to their use in construction—Stones, Bricks and Tiles; Lime, Cement, different types of Mortars and Concrete.

Specific use of ferro cement, fibre reinforced C. C., High stength concrete.

Timber; Properties defects—common preservation treatments.

Use and selection of materials for specific use like Low Cost Housing, Mass Housing.

High Rise Buildings.

1.2 Construction :

Masonry principles using Brick, stone, Blocks— construction detailing and strength characteristics.

Types of plastering, pointing, flooring, roofing and construction features.

Common repairs in buildings.

Principle of functional planning of building for residents and specific use—Building code provisions.

Basic principles of detailed and approximate estimating—specification writing and rate analysis-principles of valuation of real property.

Machinery for earthwork, concreting and their specific uses—Factors affecting selection of equipments—operating cost of equipments.

1.3 CONSTRUCTION PLANNING AND MANAGEMENT :

Construction activity—schedules—organization for construction industry—Quality assurance principles.

Use Basic principle of network analysis in form of CPM and PERT—their use in construction monitoring. Cost optimization and resource allocation.

Basic principles of Economic analysis and methods.

Project profitability—Basic principles of Boot approach to financial planning-simple toll fixation criterions.

2. Surveying and Transportation Engineering

2.1 Surveying : Common methods and instruments for distance and angle measurement for CE work—their use in plane table, traverse survey, levelling work, triangulation, contouring and topographical map.

Basic principles of photogrammetry and remote sensing.

2.2 Railways Engineering : Permanent way— components, types and their function-Functions and Design constituents of turn and crossing— Necessity of geometric design of track—Design of station and yards.

2.3 Highway Engineering :

Principles of Highway alignments—classification and geometrical design elements and standards for Roads.

Pavement structure for flexible and rigid pavements—Design principles and methodology of pavements.

Typical construction methods and standards of materials for stabilized soil, WBM, Bituminous works and CC roads.

Surface and sub-surface drainge arrangements for roads—culvert structures.

Pavement distresses and strengthening by overlays.

Traffic surveys and their application in traffic planning—Typical design features for channelized, intersection rotary etc.—signal designs—standard Traffic signs and markings.

3. Hydrology, Water Resources and Engineering :

3.1 Hydrology :

Hydrological cycle, precipitation, evaporation, transpiration, infiltration, overland flow, hydrograph, flood frequency analyses, flood routing through a reservoir, channel flow routing—Muskingam method.

3.2 Ground Water flow :

Specific yield, storage coefficient, coefficient of permeability, confined and unconfined aquifers, aquifers, aquitards, radial flow into a well under confined and unconfined conditions.

3.3 Water Resources Engineering :

Ground and surface water resources, single and multipurpose projects, storage capacity of reservoirs, reservoir losses, reservoir sedimentation.

3.4 **Irrigation Engineering :**

(i) Water requirements of crops : consumptive use, duty and delta, irrigation methods and their efficiencies.

(ii) Canals : Distribution systems for cannal irrigation, canal capacity, canal losses, alignment of main and distributory canals, most efficient section, lined canals, their design, regime theory, critical shear stress, bed load.

(iii) Water logging : causes and control, salinity.

(iv) Canal structures : Design of head regulators, canal falls, aqueducts, metering flumes and canal outlets.

(v) Diversion head work : Principles and design of weirs on permeable and impermeable foundation, Khosla's theory, energy dissipation.

(vi) Storage works : Types of dams, design, principles of rigid gravity stability analysis.

(vii) Spillways : Spillway types, energy dissipation.

(viii) River training : Objectives of river training, methods of river training.

4. Environmental Engineering

4.1 **Water Supply :**

Predicting demand for water, impurities of water and their significance, physical, chemical and bacteriological analysis, waterborne diseases, standards for potable water.

4.2 **Intake of Water :**

Water treatment: principles of coagulation, flocculation and sedimentation; slow-, rapid-, pressure-, filters; chlorination, softening, removal of taste, odour and salinity.

4.3 **Sewerage Systems :**

Domestic and industrial wastes, store sewage— separate and combined systems, flow through sewers, design of sewers.

4.4 **Sewage Characterisation :**

BOD, COD, solids, dissolved oxygen, nitrogen and TOC. Standards of disposal in normal water course and on land.

4.5 **Sewage Treatment :**

Working principles, units, chambers, sedimentation tank, trickling filters, oxidation ponds, activated sludge process, septic tank, disposal of sludge, recycling of waste water.

4.6 **Solid waste :**

Collection and disposal in rural and urban contexts, management of long-term ill-effects.

5. **Environmental pollution :**

Sustainable development. Radioactive wastes and disposal. Environmental impact assessment for thermal power plants, mines, river valley projects. Air pollution. Pollution control acts.

Syllabus for the post of Assistant Professor (Computer Engineering / Computer Science & Engineering / Computer Science & IT)

Unit – I (Discrete Structures)	**Discrete Mathematics :** Propositional and first order logic. Sets, relations, functions, partial orders and lattices. Monoids, Groups. Graphs: connectivity, matching, Combinatorics: counting, recurrence relations, generating functions. **Graph Theory:** Simple Graph, Multigraph, Weighted Graph, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, Planner graph, Graph Coloring, Trees and Rooted Trees, Prefix Codes, Tree Traversals, Spanning Trees and Cut-Sets.
Unit – II (Computer Organisation and Architecture)	**Digital Logic Circuits and Components:** Digital Computers, Logic Gates, Boolean Algebra, Map Simplifications, Combinational Circuits, Flip-Flops, Sequential Circuits, Integrated Circuits, Decoders, Multiplexers, Registers and Counters, Memory Unit. **Data Representation:** Data Types, Number Systems and Conversion, Complements, Fixed Point Representation, Floating Point Representation, Error Detection Codes. Computer Arithmetic - Addition, Subtraction, Multiplication and Division Algorithms. **Central Processing Unit:** General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, RISC Computer, CISC Computer, Pipeline and Vector Processing: Parallel Processing, Pipelining. **Input-Output Organization:** Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, DMA, Serial Communication.
Unit – III (Programming Languages)	**Elementary Data Types:** Properties of Types and Objects; Scalar and Composite Data Types. **Programming in C:** Tokens, Identifiers, Data Types, Sequence Control, Subprogram Control, Arrays, Structures, Union, String, Pointers, Functions, File Handling, Command Line Arguments, Pre-processors. **Object Oriented Programming:** Class, Object, Instantiation, Inheritance, Encapsulation, Abstract Class, Polymorphism. **Programming in C++:** Tokens, Identifiers, Variables and Constants; Data types, Operators, Control statements, Functions Parameter Passing, Virtual Functions, Class and Objects, Constructors and Destructors, Overloading, Inheritance, Templates, Exception and Event Handling, Streams and Files.
Unit – IV (Data Structure and Algorithms)	**Data Structures: Arrays and their Applications;** Sparse Matrix, Stacks, Queues, Priority Queues, Linked Lists, Trees, Forest, Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree, B Tree, B+ Tree, Sorting and Searching Algorithms, Hashing. **Performance Analysis of Algorithms and Recurrences:** Time and Space Complexities; Asymptotic Notation, Recurrence Relations. **Graph Algorithms:** Breadth-First Search, Depth-First Search, Shortest Paths, Maximum Flow, Minimum Spanning Trees.

Unit – V (Operating System)	**Basics of Operating Systems:** Operating System Structure, Operations and Services, System Calls, Operating-System Design and Implementation, System Boot. **Process Management:** Process Scheduling and Operations; Interprocess Communication. Communication in Client–Server Systems. Process Synchronization, Critical-Section Problem, Semaphores, Synchronization. **CPU Scheduling:** Scheduling Criteria and Algorithms; Thread Scheduling, Multiple Processor Scheduling, Real-Time CPU Scheduling. **Deadlocks:** Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Avoidance and Detection, Recovery from Deadlock. **Memory Management:** Contiguous Memory Allocation, Swapping, Paging, Segmentation, Demand Paging, Page Replacement, Allocation of Frames, Thrashing.
Unit – VI (Compiler Design)	**Syntax Analysis:** Associativity, Precedence, Grammar Transformations, Top Down Parsing, Recursive Descent Predictive Parsing, LL(1) Parsing, Bottom up Parsing, LR Parser, LALR(1) Parser. **Semantic Analysis:** Attribute Grammar, Syntax Directed Definitions, Inherited and Synthesized Attributes; Dependency Graph, Evaluation Order, S-attributed and L-attributed Definitions; Type-Checking. **Intermediate Code Generation:** Intermediate Representations, Translation of Declarations, Assignments, Control Flow, Boolean Expressions and Procedure Calls. **Code Generation and Code Optimization**: Control-flow, Data-flow Analysis, Local Optimization, Global Optimization, Loop Optimization, Peep-Hole Optimization, Instruction Scheduling.
Unit – VII (Database Management System)	**Database System Concepts and Architecture:** Data Models, Schemas, and Instances, Three-Schema Architecture and Data Independence, Centralized and Client/Server Architectures for DBMS. **Data Modeling:** Entity-Relationship Diagram, Relational Model - Constraints, Languages, Design, and Programming, Relational Database Schemas, Update Operations, Relational Algebra and Relational Calculus, Codd Rules. **SQL:** Data Definition and Data Types, Constraints, Queries, Insert, Delete, and Update Statements; Views, Stored Procedures and Functions, Database Triggers, SQL Injection. **Normalization for Relational Databases:** Functional Dependencies and Normalization, Algorithms for Query Processing and Optimization, Transaction Processing, Concurrency Control Techniques, Database Recovery Techniques.
Unit – VIII (Software Engineering)	**Software Process Models:** Software Process, Generic Process Model – Framework Activity, SDLC. **Software Requirements:** Functional and Non-Functional Requirements; Eliciting Requirements, Developing Use Cases, Requirement Analysis and Modelling; Requirements Review, Software Requirement and Specification (SRS) Document. **Software Design:** Object-Oriented Design, Data Design, Architectural Design, User Interface Design, Component Level Design.

	Software Quality: McCall's Quality Factors, Quality Control, Quality Assurance, Risk Management, Risk Mitigation, Monitoring and Management (RMMM), Software Reliability. **Estimation and Scheduling of Software Projects:** Software Sizing, LOC and FP based Estimations, Estimating Cost and Effort, Estimation Models, Project Scheduling and Staffing.
Unit – IX (Artificial Intelligence and Neural Network)	**Approaches to AI**: Turing Test and Rational Agent Approaches, State Space Representation of Problems, Heuristic Search Techniques, Game Playing, Min-Max Search, Alpha Beta Cutoff Procedures. **Fuzzy Sets:** Notion of Fuzziness, Membership Functions, Fuzzification and Defuzzification; Operations on Fuzzy Sets, Fuzzy Functions and Linguistic Variables; Fuzzy Relations, Fuzzy Rules and Fuzzy Inference, Fuzzy Control System and Fuzzy Rule Based Systems. **Genetic Algorithms (GA):** Encoding Strategies, Genetic Operators, Fitness Functions and GA Cycle, Problem Solving using GA. **Artificial Neural Networks (ANN):** Supervised, Unsupervised and Reinforcement Learning, Single Perceptron, Multi Layer Perceptron, Self Organizing Maps, Hopfield Network.
Unit – X (Computer Networks)	**Network Models:** Layered Architecture, OSI Reference Model and its Protocols, TCP/IP Protocol Suite, Physical, Logical, Port and Specific Addresses, Switching Techniques. **Network Security:** Malwares, Cryptography and Steganography, Secret-Key Algorithms, Public-Key Algorithms, Digital Signature, Virtual Private Networks, Firewalls. **Cloud Computing and IoT:** SaaS, PaaS, IaaS, Public and Private Cloud, Virtualization, Virtual Server, Cloud Storage, Database Storage, Resource Management, Service Level Agreement, Basics of IoT.

Syllabus for the Posts of Assistant Professor in Electronics & Communication Engineering

Section 1: Networks, Signals and Systems.

Circuit Analysis: Node and mesh analysis, superposition Theorem, Thevenin's theorem, Norton's theorem, Sinusoidal steady state analysis: phasors, complex power, maximum power transfer. Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform, Linear 2-port network parameters, Y-Delta transformation.

Continuous-time Signals: Fourier series and Fourier transform, sampling theorem and applications.

Discrete-time Signals: DTFT, DFT, z-transform, discrete-time processing of continuous-time signals.

LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.

Section 2: Electronic Devices

Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors. Carrier Transport: diffusion current, drift current, mobility and resistivity, generation and recombination of carriers.

P-N junction, Zener diode, JFET, BJT, LED, photo diode , MOS capacitor, band diagrams at equilibrium, accumulation, depletion and inversion, threshold voltage, body effect. MOSFET-structure, types, different modes and CV characteristics and equations. Short channel effects.

Semiconductor power diodes, transistors, thyristors, triacs, LASCR, GTOs, MOSFETs and IGBTs – static characteristics and principles of operation.

Section 3: Analog Circuits

Diode Circuits: clipping, clamping and rectifiers.

BJT and MOSFET Amplifiers: biasing, ac coupling, small signal analysis, frequency response. Small Signal Equivalent circuits of diodes, BJTs, MOSFETs. Biasing and bias stability of transistor and FET amplifiers. Single-and multi-stage, tuned voltage, operational, feedback, and power amplifiers. Frequency response of amplifiers. Current mirrors and differential amplifiers.

Op-amp Circuits: Simple op-amp circuits-Amplifiers, summers, differentiate, integrator, active filters, Sinusoidal oscillators; waveform generators criterion for oscillation; Schmitt triggers and oscillators, Comparators, Precision rectifiers, wave-shaping circuits, 555 Timers IC and its applications, Power supplies, IC regulators.

Section 4: Digital Circuits

Number Representations: binary, integer and floating-point- numbers, Number systems: Binary, decimal, octal, hexadecimal, BCD number systems and their conversions, Binary and hexadecimal addition, subtraction.

Combinational circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates, arithmetic circuits, code converters, multiplexers, decoders.

Sequential Circuits: latches and flip-flops, counters, shift-registers, finite state machines, propagation delay, setup and hold time, critical path delay.

Data Converters: Sample and hold circuits, ADCs and DACs.

Semiconductor Memories: ROM, SRAM, DRAM.

Section 5: Control Systems

Basic control system components; Feedback systems-open & close loop types ; Transfer function; Block diagram representation; Signal flow graph and their use in determining transfer functions of systems; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz criterion, Bode and Nyquist plots and stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.

Section 6: Analog Communication

Random Processes: auto correlation and power spectral density, properties of white noise, filtering of random signals through LTI systems.

Analog Communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, super heterodyne receivers.

Information Theory: entropy, mutual information and channel capacity theorem.

Section 7:Digital Communication

Basics, Sampling, PCM, DPCM, digital modulation schemes (ASK, PSK, FSK, QAM), bandwidth, inter-symbol interference, MAP, ML detection, matched filter receiver, SNR and BER.

Multiple access techniques: TDMA, FDMA, CDMA.
Fundamentals of error correction, Hamming codes, CRC.

Section 8: Electromagnetics

Maxwell's Equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector.

Plane Waves and Properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth.

Transmission Lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Waveguides- Basics-Rectangular types, modes, cut-off frequency ,dispersion ,dielectric types, Antennas-radiation pattern, dipole and monopole antennas, gain, linear antenna arrays, uses.

Section 9: Electronic Measurement and Instrumentation

Electronic Measurements and Instrumentation: Principles of measurement, accuracy, precision and standards; Analog and Digital systems for measurement, measuring instruments for

different applications; Static/dynamic characteristics of measurement systems, errors, statistical analysis and curve fitting; Measurement systems for non-electrical quantities; Different types of transducers and displays; Data acquisition system basics.

Section 10: Advanced Electronics & Communication

Wireless & Optical Communication: Basics of Wireless Communication, Cellular Concept, Small-Scale fading and Multipath Propagation, Equalization, Diversity, Basics of Optical Communication, Transmission, Characteristics of Optical Fibers, Optical Sources and Detectors;
Communication networks: Principles / technologies /uses /OSI model /security; Basic packet multiplexed streams/scheduling;
Digital Signal Processing: Discrete-time signal and linear systems, Realization of digital systems, Design of digital filters – IIR and FIR, Finite word length effects, Digital signal processing applications;
IC fabrication and Circuits: Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photo lithography and n-well, p-well and twin-tub CMOS process, Issues and Challenges in IC Design, MOSFET fabrication, Design of MOSFFT based digital ICs, IC Layout; VLSI Technology: Basic Electrical Properties of MOS circuits, Circuit Characteristic, Dynamic CMOS Design, Design of Subsystem.
IOT and Embedded System: Basic Microcontrollers 8051and ARM, Block diagram, Interfacing, Embedded Firmware, IOT Hardware, IOT Communication and Connectivity, IOT Data management, IOT SMART Applications and protocols.

Syllabus for the Posts of Assistant Professor Electrical and Electronics Engineering

Module 1: Electric circuit and Networks

Ideal voltage and current sources, dependent sources, R, L, C and M elements, KCL, KVL, Node and Mesh analysis, Network Theorems, Thevenin's, Norton's, Millman's, superposition and maximum power transfer theorem, Sinusoidal steady state analysis: phasors, complex power and power factor in ac circuits., maximum power transfer; Time and frequency domain analysis of linear circuits: RL, RC and RLC circuits, solution of network equations using Laplace transform. Linear 2-port network parameters, balanced three phase circuits, star-delta transformation, transient response of DC and AC networks, Resonance, ideal current and voltage sources, Source conversions, Circuit solution using network theorems, two-port networks, network parameters: driving point and transfer functions, Solutions of network equations using Laplace transform.

Filters - low pass, high pass and band-pass filters.

Module2. Signals and Systems:

Continuous-time Signals: Representation of Continuous time signal, Types ,Properties, Fourier series and Fourier transform, sampling theorem and applications.

Discrete-time Signals: Representation and Properties, DTFT, DFT, FFT, z-transform, discrete-time processing of continuous-time signals, Laplace transform.

LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeroes, frequency response, group delay, phase delay.

Module 3: Electromagnetics Field Theory

Gauss's Law and applications, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Stoke's theorem, scalar and vector magnetic potential, Lorentz force; Inductance, MMF, reluctance, Magnetic circuits.

Maxwell's Equations: differential and integral forms and their interpretation, boundary conditions, wave equation, Poynting vector.

Plane Waves and Properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth.

Module 4: Digital Electronics and Microprocessor

Number Representations: binary, integer and floating-point- numbers, Number systems: Binary, decimal, octal, hexadecimal, BCD number systems and their conversions, Binary and hexadecimal addition, subtraction.

Combinational circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates, arithmetic circuits, code converters, multiplexers, decoders.

Sequential Circuits: latches and flip-flops, Synchronous and asynchronous counters, shift-registers, finite state machines, propagation delay, setup and hold time, critical path delay.

Data Converters: sample and hold circuits, ADCs and DACs.

Semiconductor Memories: ROM, SRAM, DRAM.

Microprocessor(8085): architecture, addressing modes, instruction set, interrupts, Programming, Memory and I/O interfacing.

Module 5: Electronics Devices & Analog Circuits

Energy bands in intrinsic and extrinsic semiconductors, equilibrium carrier concentration, direct and indirect band-gap semiconductors. Carrier Transport: diffusion current, drift current, mobility and resistivity, generation and recombination of carriers.

PN junction, Zener diode, LEDs, Diode Circuits: clipping, clamping and rectifiers.BJT, JFET, MOSFET. MOSFET- structure, types, different modes and CV characteristics and equations.

BJT and MOSFET Amplifiers: biasing, ac coupling, small signal analysis, frequency response BJTs, FET, MOSFETs. Biasing and bias stability of transistor and FET amplifiers. Single-and multi-stage Amplifiers, feedback Amplifiers-Topologies and analysis, Oscillators-Types and analysis and power amplifiers. Frequency response of amplifiers , Differential amplifiers.

Op-amp Circuits: Simple op-amp circuits-Amplifiers, summers, differentiate, integrator, active filters. Sinusoidal oscillators; waveform generators criterion for oscillation; Schmitt triggers and oscillators, Comparators, Precision rectifiers, wave-shaping circuits, 555 Timers IC and its applications.

Module 6: Electrical Machines

Single phase and three phase transformers – leakage reactance, equivalent circuit, losses and efficiency, voltage regulation, OC, SC and Sumpner's tests, Distribution transformer, all day efficiency, autotransformer – saving of copper three phase transformer – connections, vector groupings, parallel operation.

DC machines – Types of excitation, constructional features, characteristics, applications DC generator – Emf equation, armature reaction & commutation, characteristics, voltage build up, applications. DC motor – Torque equation, characteristics of shunt, series & compound motors, necessity & types of starters, speed control, applications, Swinburne's test, Hopkinson's test. Synchronous machines: - constructional features, winding factor, characteristics, Alternator: Types, synchronous reactance, voltage regulation, emf and mmf methods, short circuit ratio, two reaction theory, alternator on infinite bus, power angle characteristics, parallel operation, effect of variation of power input & excitation. Synchronous motor – principle of operation, methods of starting, hunting & its reduction. Three phase induction motor – constructional features, types, slip rotor frequency, power flow, Torque – slip curve, effect of rotor resistance, starting methods, speed control. Single phase induction motor – double field revolving theory .

Module 7: Control Systems

Open loop and closed loop system – transfer function, force-voltage & force-current analogy, block diagrams, signal flow graphs – Mason's gain formula – characteristic equation, time domain analysis – transient & steady state responses – time domain specifications & steady state error. Concept of stability – Routh's stability criterion – Root locus – effect of addition of poles and zeros. Frequency domain analysis – Nyquist & Bode plots, gain margins and phase

margin, lag, lead and lag-lead compensators and their design using Bode plot. State space analysis of system – state space models, state transition matrix, relationship between state equations and transfer function, controllability and observability. Nonlinear system – characteristics, types of non-linearities, describing functions, analysis – concept, singular points – focus, centre, node and saddle points – limit cycle.

Module 8: Power Electronics

Thyristors, DIAC, TRIAC, LASCRs, GTOs, MOSFETs & IGBTs – Construction, principles of operation, triggering circuits, phase-controlled rectifiers (Semi/Fully Controlled), bridge converters – fully controlled and half controlled. Cyclo-converters, Single-Phase and Three-Phase AC to DC converters.UJT, Triggering circuits, choppers, Inverters – voltage source inverters– single phase half-bridge & full bridge inverter, pulse width modulation. Voltage control and harmonic minimization in inverters, AC regulators, Three phase controlled rectifier; DC-DC converters – step-down and step-up choppers – single quadrant, two-quadrant & four quadrant chopper – pulse width modulation, Switching Regulators-buck, boost & buck-boost, Switch mode power supply; Uninterrupted power supply,. Residential and industrial applications of Power Electronics.

Module 9: Measurements and Instrumentation

Basics of Measurements: Accuracy, Precision, resolution, reliability, Errors and their analysis, Standards of measurement. Principles of PMMC, moving iron, and electrodynamometer type instruments, error analysis, measurement of voltage, current, power energy and power factor, Induction type watt-hour meter, magnetic measurements, Instrument transformers, digital voltmeters and multimeters, digital measurements of frequency, phase angle and time interval. Electronic energy meter, high voltage measurements. Measurement systems for non-electrical quantities; Different types of transducers and displays; Transducers for temperature, force, flow and pressure, AC and DC Bridges and their applications.

Oscilloscopes: Cathode Ray Tube, Oscilloscope measurement Techniques, Special Oscilloscopes – Storage Oscilloscope, Sampling Oscilloscope. Signal Generators: Sine wave

generator, Frequency – Synthesized Signal Generator, Sweep frequency Generator, Pulse and square wave generators, Function Generators.

Signal Analysis: Wave Analyzer, Spectrum Analyzer. Frequency Counters: Simple Frequency Counter; Measurement errors; extending frequency range of counters. Instrumentation Amplifier, Isolation Amplifier, An Introduction to Computer-Controlled Test Systems.IEEE-488 GPIB Bus.

Module 10: Power Systems

Conventional and non-conventional systems of power generation, power plant economics, load factor, demand factor, diversity factor, Transmission line parameters – inductance and capacitance of transmission lines, T and Π models, GMD and GMR, ABCD constants, overhead lines – arrangement of conductors – sag, economic span, choice of transmission voltage, types of insulators, string efficiency, distribution systems – types, comparison of DC and AC single phase and 3 phase systems. Formation of Y bus and Z Bus. Load flow studies – Gauss Seidal, Newton Raphson and Fast decoupled load flow methods.

Faults on power systems – LG, LL, LLG and 3 phase faults. Fault analysis using Z Bus. Power system stability, steady state transient and dynamic stability, equal area criterion, swing curve. Protective relays: types and operation, protective zones, different protection schemes.

Circuit breakers – types and operations, selection of circuit breakers, calculation of fault KVA, protection against lightning and over voltages. Electric traction – speed – time curves – mechanics Electric heating – Advantages, types and applications. Tariff, Corona, UG cables

Functions of MCB, MCCB, RCCB, necessity of earthing, types of lamps, illumination design.

ELECTRICAL ENGINEERING

1. Circuits—Theory :

Circuit components; network graphs: KCL, KVL; Circuit analysis methods : nodal analysis, mesh analysis; basic network theorems and applications; transient analysis : RL, RC and RLC circuits; sinusoidal steady state analysis; resonant circuits, coupled circuits; balanced 3-phase circuits. Two-port networks.

2. Signals and Systems :

Representation of continuous-time and discrete-time signals and systems; LTI systems, convolution; impulse response; time-domain analysis of LTI systems based on convolution and differential/difference equations. Fourier transform, Laplace transform, Z-transform, Transfer function. Sampling and recovery of signals DFT, FFT Processing of analog signals through discrete-time systems.

3. E.M. Theory :

Maxwell's equations, wave propagation in bounded media. Boundary conditions, reflection and refraction of plane waves. Transmission lines : travelling and standing waves, impedance matching, Smith chart.

4. Analog Electronics :

Characteristics and equivalent circuits (large and small-signal) of Diode, BJT, JFET and MOSFET. Diode circuits : Clipping, clamping, rectifier. Biasing and bias stability. FET amplifiers. Current mirror; Amplifiers : single and multi-stage, differential, operational feedback and power. Analysis of amplifiers; frecuency-response of amplifiers. OPAMP circuits. Filters; sinusoidal oscillators : criterion for oscillation; single-transistor and OPAMP configurations. Function generators and wave-shaping circuits. Linear and switching power supplies.

5. Digital Electronics :

Boolean algebra; minimisation of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS). Combinational circuits : arithmetic circuits, code converters, multiplexers and decoders. Sequential circuits: latches and flip-flops, counters and shift-registers. Comparators, timers, multivibrators. Sample and hold circuits, ADCs and DACs. Semiconductor memories. Logic implementation using programmable devices (ROM, PLA, FPGA).

6. Energy Conversion :

Principles of electromechanical energy conversion : Torque and emf in rotating machines. DC machines : characteristics and performance analysis; starting and speed control of motors. Transformers : principles of operation and analysis; regulation, efficiency; 3-phase transformers. 3-phase induction machines and synchronous machines : characteristics and performance analysis, speed control.

7. Power Electronics and Electric Drives :

Semi-conductor power devices : diode, transistor, thyristor, triac, GTO and MOSFET-static characteristics and principles of operation; triggering circuits; phase control rectifiers; bridge converters : fully-controlled and half-controlled; principles of thyristor choppers and inverters; DC-DC converters; Switch mode inverter; basic concepts of speed control of dc and ac motor drives applications of variable-speed drives.

8. Analog Communication :

Random variables : continuous, discrete; probability, probability functions. Statistical averages; probability models; Random signals and noise : white noise, noise equivalent bandwidth; signal transmission with noise, signal to noise ratio. Linear CW modulation : Amplitude modulation : DSB, DSB-SC and SSB. Modulators and Demodulators. Phase and Frequency modulation : PM & FM signals, narrows band FM; generation & detection of FM and PM. Deemphasis, Preemphasis. CW modulation system : Superhetrodyne

receivers, AM receivers, communication receivers. FM receivers, phase locked loop, SSB receiver Signal to noise ratio calculation or AM and FM receivers.

1. Control Systems :

Elements of control systems; block-diagram representations; open-loop & closed-loop systems; principles and applications of feed-back. Control system components. LTI systems : time-domain and transform-domain analysis. Stability : Routh Hurwitz criterion, root-loci, Bode-plots and polor plots, Nyquist's criterion; Design of lead-lad compensators. Proportional, PI, PID controllers. State-variable representation and analysis of control systems.

2. Microprocessors and Microcomputers :

PC organisation; CPU, instruction set, register settiming diagram, programming, interrupts, memory interfacing, I/O interfacing, programmable peripheral devices.

3. Measurement and Instrumentation :

Error analysis; measurement of current voltage, power, energy, power-factor, resistance, inductance, capacitance and frequency; bridge measurements. Signal conditioning circuit; Electronic measuring instruments : multimeter, CRO, digital voltmeter, frequency counter, Q-meter, spectrum-analyser, distoration-meter. Transducers : thermocouple, thermistor, LVDT, strain-guage, piezo-electric crystal.

4. Power Systems: Analysis and Control :

Steady-state performance of overhead transmission lines and cables; principles of active and reactive power transfer and distribution; per-unit quantities; bus admittance and impedance matrices; load flow; voltage control and power factor correction; economic operation; symmetrical components, analysis of symmetrical and unsymmetrical faults. Concepts of system stability : swing curves and equal area criterion. Static VAR system. Basic concepts of HVDC transmission.

5. Power System Protection :

Principles of overcurrent, differential and distance protection. Concept of solid state relays. Circuit brakers. Computer aided protection : introduction; line, bus, generator, transformer protection; numeric relays and application of DSP to protection.

6. Digital Communication :

Pulse code modulation (PCM), defferential pulse code modulation (DPCM), delta modulation (DM). Digital modulation and demodulation schemes : amplitude, phase and frequency keying schemes (ASK, PSK, FSK). Error control coding : error detection and correction, linear block codes, convolation codes. Information measure and source coding. Data networks, 7-layer architecture.

MECHANICAL ENGINEERING

1. Mechanics :

1.1 Mechanics of Rigid Bodies :

Equations of equilibrium in space and its application; first and second moments of area; simple problems on friction: kinematics of particles for plane motion; elementary particle dynamics.

1.2 Mechanics of Deformable Bodies :

Generalized Hooke's law and its application; design problems on axial stress, shear stress and bearing stress; material properties for dynamic loading; bending shear and stresses in beams: determination of principle stresses and strains-analytical and graphical; compound and combined stresses; bi-axial stresses-thin walled pressure vessel; material behaviour and design factors for dynamic load; design of circular shafts for bending and torsional load only: deflection of beam for statically determinate problems; theories of failure.

2. Engineering Materials :

Basic concepts on structure of solids, common ferrous and non-ferrous materials and their applications: heat-treatment of steels; non-metalsplastics, cermics, composite materials and nano-materials.

3. Theory of Machines :

Kinematic and dynamic analysis of plane mechanisms. Cams, Gears and empicyclie gear trains, flywheels, governors, balancing of rigid rotors, balancing of single and multicy-linder engines, linear vibration analysis of mechanical systems (single degree of freedom), Critical speeds and whirling of shafts.

4. Manufacturing Science :

4.1 Manufacturing Process:

Machine tool engineering - Merhant's force analysis. Taylor's tool life equation; conventional machining. NC and CNC machining process; jigs and fixtures.
Non-conventional machining-EDM, ECM, ultrasonic, water jet machining etc.; application of lasers and plasmas; energy rate calculations.
Forming and welding processes-standard processes.
Metrology-concept of fits and tolerances; tools and guages; comparators; inspection of length, position; profile and surface finish.

4.2 Manufacturing Management :

System design: factory location—simple OR models; plant layout-methods based; applications of engineering economic analysis and break-even analysis for product selection, process selection and capacity planning; predetermined time standards.
System planning; forecasting methods based on regression and decomposition, design and blancing of multi model and stochastic assembly lines; inventory management-probablistic inventory models for order time and order quanitity determination; JIT systems; strategic sourcing; managing inter plant logistics.
System operations and control: Scheduling algorithms for job shops; applications of statistical methods for product and process quality control applications of control charts for mean, range, percent defective, number of defectives and defects per unit; quality cost systems; management of resources, organizations and risks in projects.
System improvement: Implementation of systems, such as total quality management, developing and managing flexible, lean and agile Organizations.

2. Thermodynamics, Gas Dynamics Turbine :

1.1 Basic concept of First-law and Second law of Thermodynamics; concept of entropy and reversibility; availability and unavailability and irreversibility.

1.2 Classification and properties of fluids; incompressible and compressible fluids flows; effect of Mach number and compressibility; continuity momentum and energy equations; normal and oblique shocks; one dimensional isentropic flow; flow or fluids in duct with frictions that transfer.

1.3 Flow through fans, blowers and compressors; axial and centrifugal flow configuration; design of fans and compressors; single problems compresses and turbine cascade; open and closed cycle gas turbines; work done in the gas turbine; reheat and regenerators.

2. Heat Transfer :

2.1 Conduction heat transfer—general conduction equation-Laplace, Poisson and Fourier equations; Fourier law of conduction; one dimensional steady state heat conduction applied to simple wall, solid and hollow cylinder and spheres.

2.2 Convection heat transfer—Newton's law of convection; free and forces convection; heat transfer during laminar and turbulent flow of an incompressible fluid over a flat plate; concepts of Nusselt number, hydrodynamic and thermal boundary layer their thickness; Prandtl number; analogy between heat and momentum transfer—Reynolds, Colburn, Prandtl analogies; heat transfer during laminar and turbulent flow through horizontal tubes; free convection from horizontal and vertical plates.

2.3 Black body radiation—basic radiation laws such as Stefan-boltzman, Planck distribution, Wein's displacement etc.

2.4 Basic heat exchanger analysis; classification of heat exchangers.

3. Engines :

3.1 Classification, themodynamic cycles of operation; determination of break power, indicated power, mechanical efficiency, heat balance sheet, interpretation of performance characteristics, petrol, gas and diesel engines.

3.2 Combustion in SI and CI engines, normal and abnormal combustion; effect of

working parameters on knocking, reduction of knocking; Forms of combustion chamber for SI and CI engines; rating of fuels; additives; emission.

3.3 Different systems of IC engines-fuels; lubricating; cooling and transmission systems. Alternate fuels in IC engines.

4. Steam Engineering :

4.1 Steam generation—modified Ranking cycle analysis; Modern steam boilers; steam at critical and supercritical pressures; draught equipment; natural and artificial draught; boiler fuels solid, liquid and gaseous fuels. Steam turbines— Principle; types; compounding; impulse and reaction turbines; axial thrust.

4.2 Steam nozzles—flow of steam in convergent and divergent nozzle pressure at throat for maximum discharge with different initial steam conditions such as wet, saturated and superheated, effect of variation of back pressure; supersaturated flow of steam in nozzles, Wilson line.

4.3 Rankine cycle with internal and external irreversibility; reheat factor; reheating and regeneration, methods of governing; back pressure and pass out turbines.

4.4 Steam power plants—combined cycle power generation; heat recovery steam generators (HRSG) fired and unfired, co-generation plants.

5. Refrigeration and Air-conditioning :

5.1 Vapour compression refrigeration cycle—cycle on p-H & T-s diagrams; ecofriendly refrigerants—R 134a. 123; Systems like evaporators, condensers, compressor, expansion devices. Simple vapour absorption systems.

5.2 Psychrometry—properties; processes; charts; sensible heating and cooling; humidification and dehumidification effective temperature; air-conditioning load calculation; simple duct design.

Jammu and Kashmir Public Service Commission

Physical Training Instructor Syllabus

Unit – 1:

Introduction to physical education

The Unitary Aspect of Man. The nature of physical education outcomes of physical education Changing trends and career in physical education, concept and principles of integral physical education. Movement as a process of integration. Physical education meaning and source of its principles

Physical education –its Humanistic Foundation

Physical education in ancient nations (Greece, Rome)
Physical education during the Dark Ages and middle Ages
European background for modern physical education
Physical education in the Twentieth century
Trilogy of Great Leaders of physical education
History of physical education in India
Sports schemes in India

Physical education its Philosophical Bases

Components of philosophy
Traditional Philosophy
Implication of philosophy for physical education

Olympic Movement

Ancient and modern Olympic games
Asian games
South Asian Federation Games
Afro –Asian Games
Structure and functions of international bodies controlling various games and sports
Prominent honours and awards in games and sports.

Unit – 2:

Anatomical and physiological bases

Biological basis of life
Biological weaknesses
The Skeleton (Axial and Appendicular)
Joint and lever system
The muscles
The nervous system

Human growth and development

Genetics
Body types
Posture and body mechanics
Health and fitness
The fitness cycle
Types of fitness

Health (community health, school health and personal health)
Hypokinetic diseases
Benefits of exercise to the (Respiratory system, Muscular system, vital organs and nutritive system

Anthropological bases

Biological Evolution
Cultural Evolution
Implication of anthropology for the physical education

Sports training and Therapeutic modalities

Principles of training
Methods of executing training load
Training plans
First –Aid and emergency treatment in various cases.
Electrical stimulation
Cryotherapy
Laser therapy, Massage and Traction

Unit – 3:

Biomechanics

Use of Biomechanics in sports
Principles of biomechanics

Analytic Biomechanical Techniques

Cinematography
Kinetography
Electromyography
Goniography

Kinetics and kinematics

Newton's Laws of motion
Centrifugal and centripetal forces
Levers
Impact and elasticity
Equilibrium, principles of equilibrium and its application in sports
Forces and its types
Friction
Osteokinetimics and arthrokinematics

Projectiles and trajectory

Factors affecting the projectile and trajectory in sports
Mechanical analysis of jumps
Mechanical of throws
Mechanical analysis of running

Unit – 4:

Learning

General assumptions about learning
Kinds of learning, conditions affecting learning

Various psychological factors that affect performance in sports
Theories of learning
Laws of learning
Adolescent problems and their management

Motivation

Internal process and external process theories
Conditions and factors for sports motivation
Levels of motivation
Role of motivation in sports
Association between motivation and mental health in sports

Personality

Dimensions of personality
Theories of personality
Assessment of personality traits
Relationship between personality and sports

Intelligence

Nature of intelligence
Approach to intelligence (Implicit approach and Explicit approach)
Measurement of intelligence
Body –mind interaction and Intelligence
Concept of athletic intelligence

Unit – 5:

History of test and measurement

Anthropometry, Muscular strength and endurance, cardiovascular measurements, Athletic ability testing, sports skill testing, power measurement, knowledge testing and social measurement,

Physical and motor fitness testing

AAHPER youth physical fitness test
National Physical Efficiency Test
Indiana Motor fitness test
Barrow general motor ability test
Newton motor ability test
Metheny –Johnson motor educability test

Cardio –pulmonary endurance

Tuttle Pulse test
Harvard step test
Run –walk test
Measurement of cardio- vascular test

Sports skill testing

Basket Ball skill tests and Badminton skill testing
Football Skill tests
Volleyball skill tests
Hockey skill test and Hand ball skill testing

Athletic s skill testing and Archery skill testing

Unit – 6:

Statistic and evaluation

Statistical concepts
Functions of statistical test
Classification of statistic
Data , its types and collecting measures
Rating scales in physical education

Sampling in research

Population and sampling
Steps in sampling process
Sampling theory
Techniques
Sampling size

Elements of research

Hypothesis
Variable
Value of hypothesis in research
Elements of a good hypothesis
Conditions for accepting and or rejecting Null hypothesis
Level of significance

Methods of research

Descriptive Research method
Historical research method
Experimental research method

Unit – 7:

Sports and social values

Sports as a socializing process
Sports in educational settings
Equity and discrimination in sports
Sports sociology in future
Principles of sports sociology
Leadership qualities

Violence in sports

Violence of sports through history
Violence on the and off the field
Assaults and sexual assaults by athletes
General factors related to violence in sports.

Sports and economics

Economic motives and the globalization of commercial sports
Corporations use sports as vehicles for global expansion

Youth sports programs and spectator interest
Out sports in action: Branding sports

Race and ethnicity

Racial concepts in sports
Sports participation among racial and ethnic minorities
Sports participation
Influence of international politics on Sports and games
Effects of Indian politics and economy on the promotion of sports events

SYLLABUS FOR THE POST OF LIBRARIAN

Unit-I

Information, Information Science, Information Society, Knowledge Society,

Information as a Resource/Commodity

Role of Information in Planning, Management, Socio-economic development,

Technology Transfer

Intellectual Property Rights, Right to Information Act, IT-Act

The Delivery of Books and Newspapers (Public Libraries) Act; and

Plagiarism

Unit-II

Types of Libraries-National, Public, Academic and Special

Historical Development of Libraries

Library and Information Policy at National Level

Role of UGC and RRLF in Growth and Development of Libraries in India

Unit-III

Five Laws of Library Science
Library Resources Sharing and Networking
Library Movement and Library Legislation in India
Library Extension Services
Library and Information Science Profession
Library Association in India
Library Association Organization at International level

Unit-IV

Sources of Information-Primary, Secondary, and Non-Documentary
Reference Sources-Print and Online
E-resources (e-books, e-journals, database, website, portals, etc)
Reference and Information Service (Traditional and Online)

Unit-V

Knowledge Organization-Classification (DDC) and Cataloguing(AACR-2)
Knowledge Management
Index and Indexing
Vocabulary Control-Thesaurus, lists of Subject Headings
Database

Unit-VI

Impact of ICT on Libraries
ICT application to Libraries
Digital Libraries Vs Virtual Libraries
Library Automation, Networking, Digitization and Telecommunication

Unit-VII

Library Management and its Administration
Collection Development-Acquisition, Organization and Maintenance, etc.
Human Resource Management, Financial Management
Library Building and other infrastructure
Marketing of Information Products and Services
TQM, Performance Evaluation of Libraries and its Services

Unit-VIII

Research methods in Libraries, Research Design, etc.
User studies, User Education
Library Metrics