

### **Syllabus for RTU-DAT Paper-I**

The syllabus for the above paper shall be divided in three parts:

1. English: Grammar, Vocabulary, Comprehension. (Constituting 20 marks, common for all RTUDAT applicants)
2. Mental ability and research aptitude: Mental ability, logical reasoning, statistical analysis, graph interpretation, Quantitative aptitude etc. (Constituting 60 marks, common for all RTUDAT applicants)
3. Department specific- In case of engineering disciplines the questions in this part will be based on the UG level syllabus of the individual department. In case of Business Administration and Computer Application the questions will be based on syllabus of major areas taught in these courses judging the general awareness in the subject area. (Constituting 20 marks, common for RTUDAT applicants of a particular department)

# **Syllabus for RTU-DAT Paper-II**

## **Discipline: Electronics & Communication Engineering**

### **Specialization: Communication Engineering**

#### **1. COMMUNICATIONS SYSTEMS**

Basic information theory; Modulation and detection in analogue and digital systems; Sampling and data reconstructions; Quantization & coding; Time division and frequency division multiplexing; Equalization; Optical Communication: in free space & fiber optic; Propagation of signals at HF, VHF, UHF and microwave frequency; Satellite Communication. Characterization of communication signals, signal space representation, equalization, matched filtering, binary PSK, QPSK, FSK, QAM & M-Ary modulation techniques and their representation. Coherent & non coherent detection, carrier & symbol synchronization, bits v/s symbol error probability, bandwidth efficiency, Spread spectrum modulation: Pseudo noise sequences, DS & FH spread spectrum.

#### **2. DIGITAL SIGNAL PROCESSING**

DFT & its properties. Decimation in time and decimation in frequency FFT algorithms, discrete cosine transform. IIR Filter design: Butterworth design, bilinear transformation. Low Pass, High Pass, Band Pass and Band Stop digital filters. Spectral transformation of IIR filters. FIR filter design: Symmetric and antisymmetric linear phase. FIR filter by rectangular, triangular and Blackman window functions. Finite word length effects in FIR and IIR digital filters: Quantization, round off errors and overflow errors. Multi rate digital signal processing: Concepts, design of practical sampling rate converters, Decimators, interpolators. Polyphase decompositions.

#### **3. ANTENNA THEORY AND TECHNIQUES**

Review of the theory of electromagnetic radiation. Introduction to various antenna types wire, loop and helical antennas, analysis using assumed current distribution. Aperture antennas: slot, wave guide, horn, and reflector antennas. Analysis using field equivalence principle and Fourier transform methods. Linear arrays. Traveling wave & broadband antennas. Antenna measurements. Printed antennas: Feeding methods, transmission line & cavity models, analysis and design of rectangular & circular microstrip antenna. Arrays: pattern synthesis, planar arrays, phased arrays. Active antennas and arrays. Paraboloidal reflector antenna, different feed configurations, shaped beam antennas, lens antenna. Antennas for biomedical applications. Smart antennas for mobile communications. Antenna for infrared detectors.

#### **4. VLSI DESIGN**

Basic operation of CMOS inverter, detailed analysis of its noise margin propagation delay, power dissipation concept of layout & area, layout optimization & area estimation for a single as well as combinational logic circuits.

Design of sequential logic circuits: Static & dynamic latches registers, dynamic transmission gate, CMOS gate, pipelining approach for optimize sequential circuits, NDRA-CMOS pipelined structure, nonbistable sequential circuits, Schmitt trigger.

Implementation strategies for digital ICs, introduction of custom and circuit design, hierarchy cell based design array based implementation, building blocks of adder, multiplier, shifter, barrel shifter, algorithmic shifter and other arithmetic operators, power speed tradeoff in data path structure.

Design memory & array structure memory architectures & building blocks, address decoder, sense amplifiers, driver/ buffers, timing control, power dissipation in memories, idea of testability and fault detection models.

## **5. HIGH FREQUENCY ELECTRONICS**

Analysis of planar transmission lines: Variational method. losses in microstrip lines, analysis & design of devices; passive circuits, impedance transformers, couplers, power dividers, filters, oscillators, mixers, switches, amplifiers (narrow band /broad band) oscillators, active & passive phase shifters.

## **Specialization: Control & Instrumentation**

### **1 MODERN CONTROL SYSTEM**

State variable analysis and design: State space model for continuous time linear system and discrete time linear system. State space representation using phase variables and canonical variables, transfer function from state model, state model from transfer function, diagonalization Eigen values and eigen vector, solution of state equation. Controllability, observability and reproducibility, controllable companion transformation, interpretation of controllability, observability criteria, duality, output function controllability, input function observability. State feedback control. State feedback and output feedback, pole assignment using state feedback and output feedback, reconstructing the state from available outputs. Analysis of state equations, Control law design for full state feedback, Selection of pole locations for good design, Estimator design, Combined control law and Estimator loop transfer recovery, Integral control and robust tracking, Design of systems with pure time delay..

### **2. DIGITAL SIGNAL PROCESSING**

DFT & its properties. Decimation in time and decimation in frequency FFT algorithms, discrete cosine transform. IIR Filter design: Butterworth design, bilinear transformation. Low Pass, High Pass, Band Pass and Band Stop digital filters. Spectral transformation of IIR filters. FIR filter design: Symmetric and antisymmetric linear phase. FIR filter by rectangular, triangular and Blackman window functions. Finite word length effects in FIR and IIR digital filters: Quantization, round off errors and overflow errors. Multi rate digital signal processing: Concepts, design of practical sampling rate converters, Decimators, interpolators. Polyphase decompositions.

### **3. BIOMEDICAL ELECTRONICS**

Brief introduction to human physiology. Biomedical transducers: displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases. Bio electrodes and bio potential amplifiers for ECG, EMG, EEG, etc. Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic and nuclear imaging. Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects. Telemetry – Transmission of the original through wire & wireless. Imaging techniques –

Ultrasound, CAT, X-Rays, PET, NMR, Nuclear. Physiological effect of electric current, safety. Cardiological Signal Processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG parameters & their estimation, the use of multi scale analysis for parameters estimation of ECG waveforms, Arrhythmia analysis, monitoring, long form continuous ECG recording. ECG data reduction technique, Direct data compression techniques, Direct ECG data compression techniques. Transformation compression techniques. Other data compression techniques. Data compression techniques, comparison.

#### **4. ARTIFICIAL NEURAL NETWORKS**

Introduction: Biological neurons and memory: Structure and function of a single neuron, artificial neural networks (ANN), typical applications of ANNs: classification, clustering, vector quantization, pattern recognition, function approximation, forecasting, control, optimization, basic approach of the working of ANN - training, learning and generalization.

Supervised Learning: single-layer networks, perceptron-linear separability, training algorithm, limitations; multi-layer networks-architecture, back propagation algorithm (BTA) and other training algorithms, applications. Adaptive multi-layer networks-architecture, training algorithms, recurrent networks, feedforward networks, radial-basis-function (RBF) networks. Unsupervised Learning: Winner-takes-all networks, hamming networks, maxnet, simple competitive learning, vector-quantization, counter propagation networks, adaptive resonance theory, Kohonen's Selforganizing Maps, principal component analysis. Associated Models: Hopfield Networks, brain-in-a-box network, Boltzmann machine. Optimization Methods: Hopfield Networks for-TSP, solution of simultaneous linear equations, Iterated gradient descent, simulated annealing, genetic algorithm.

### **Discipline: Mechanical Engineering**

#### **Specialization: Production Engineering**

**Metal Casting:** Casting processes – types and applications; patterns – types and materials; allowances; moulds and cores – materials, making, and testing; casting techniques of cast iron, steels and nonferrous metals and alloys; solidification; design of casting, gating and risering; casting inspection, defects and remedies.

**Metal Forming:** Stress-strain relations in elastic and plastic deformation; concept of flow stress, deformation mechanisms; hot and cold working – forging, rolling, extrusion, wire and tube drawing; sheet metal working processes such as blanking, piercing, bending, deep drawing, coining and embossing; analysis of rolling, forging, extrusion and wire /rod drawing; metal working defects.

**Metal Joining Processes:** Welding processes – manual metal arc, MIG, TIG, plasma arc, submerged arc, electroslag, thermit, resistance, forge, friction, and explosive welding; other joining processes – soldering, brazing, braze welding; inspection of welded joints, defects and remedies; introduction to advanced welding processes – ultrasonic, electron beam, laser beam; thermal cutting.

**Machining and Machine Tool Operations:** Basic machine tools; machining processes—turning, drilling, boring, milling, shaping, planing, gear cutting, thread production, broaching, grinding, lapping, honing, super finishing; mechanics of machining – geometry of cutting tools, chip formation, cutting forces and power requirements, Merchant’s analysis; selection of machining parameters; tool materials, tool wear and tool life, economics of machining, thermal aspects of machining, cutting fluids, machinability; principles and applications of nontraditional machining processes – USM, AJM, WJM, EDM and Wire cut EDM, LBM, EBM, PAM, CHM, ECM.

**Tool Engineering:** Jigs and fixtures – principles, applications, and design; press tools – configuration, design of die and punch; principles of forging die design.

**Metrology and Inspection:** Limits, fits, and tolerances, interchangeability, selective assembly; linear and angular measurements by mechanical and optical methods, comparators; design of limit gauges; interferometry; measurement of straightness, flatness, roundness, squareness and symmetry; surface finish measurement; inspection of screw threads and gears; alignment testing of machine tools.

**Powder Metallurgy:** Production of metal powders, compaction and sintering.

**Polymers and Composites:** Introduction to polymers and composites; plastic processing – injection, compression and blow molding, extrusion, calendaring and thermoforming; molding of composites.

**Manufacturing Analysis:** Sources of errors in manufacturing, process capability, tolerance analysis in manufacturing and assembly, process planning, parameter selection and comparison of production alternatives time and cost analysis; manufacturing technologies—strategies and selection.

**Computer Integrated Manufacturing:** Basic concepts of CAD, CAM, CAPP, cellular manufacturing, NC, CNC, DNC, Robotics, FMS, and CIM.

### **Specialization: Industrial Engineering**

**Product Design and Development:** Principles of good product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, concurrent engineering.

**Engineering Economy and Costing:** Elementary cost accounting and methods of depreciation; break-even analysis, techniques for evaluation of capital investments, financial statements.

**Work System Design:** Taylor's scientific management, Gilbreth's contributions; productivity – concepts and measurements; method study, micro-motion study, principles of motion economy; work measurement – stop watch time study, work sampling, standard data, PMTS; ergonomics; job evaluation, merit rating, incentive schemes, and wage administration; business process reengineering.

**Facility Design:** Facility location factors and evaluation of alternate locations; types of plant layout and their evaluation; computer aided layout design techniques; assembly line balancing; materials handling systems.

**Production Planning and Inventory Control:** Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; MRP and MRP-II; order control and flow control; routing, scheduling and priority dispatching; push and pull production systems, concept of JIT manufacturing system; logistics, distribution, and supply chain management; Inventory – functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems.

**Operation Research:** Linear programming – problem formulation, simplex method, duality and sensitivity analysis; transportation and assignment models; network flow models, constrained optimization and Lagrange multipliers; simple queuing models; dynamic programming; simulation – manufacturing applications; PERT and CPM, time-cost trade-off, resource leveling.

**Quality Management:** Quality – concept and costs, quality circles, quality assurance; statistical quality control, acceptance sampling, zero defects, six sigma; total quality management; ISO 9000; design of experiments – Taguchi method.

**Reliability and Maintenance:** Reliability, availability and maintainability; distribution of failure and repair times; determination of MTBF and MTTR, reliability models; system reliability determination; preventive maintenance and replacement, total productive maintenance – concept and applications.

**Management Information System:** Value of information; information storage and retrieval system – database and data structures; knowledge based systems.

**Intellectual Property System:** Definition of intellectual property, importance of IPR; TRIPS and its implications, patent, copyright, industrial design and trademark.

### **Specialization: Thermal Engineering**

**Fluid Mechanics:** Fluid properties; fluid statics, manometry, buoyancy; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc.

**Heat-Transfer:** Modes of heat transfer; one dimensional heat conduction, resistance concept, electrical analogy, unsteady heat conduction, fins; dimensionless parameters in free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence; radiative heat transfer, black and grey surfaces, shape factors, network analysis; heat exchanger performance, LMTD and NTU methods.

**Thermodynamics:** Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle, irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion.

#### **Applications:**

**Power Engineering:** Steam Tables, Rankine, Brayton cycles with regeneration and reheat.

**I.C. Engines:** air-standard Otto, Diesel cycles.

**Refrigeration and air-conditioning:** Vapour refrigeration cycle, heat pumps, gas refrigeration, Reverse Brayton cycle; moist air: psychrometric chart, basic psychrometric processes.

**Turbomachinery:** Pelton-wheel, Francis and Kaplan turbines — impulse and reaction principles, velocity diagrams.

### **Specialization: Machine Design**

**Design of Machine Elements:** Manufacturing Aspects in Design, Allowable stresses, factor of safety, Design of machine elements subjected to direct stress, pin, cotter and keyed joints, design of screw fastening. Design of Beams, levers and laminated springs. Design of shafts and shaft couplings. Design of brackets, screw fasteners subjected to eccentric loading.

Fatigue Considerations in Design, Design of machine members subjected to variable loading, Design for finite life. Pre Loading of Bolts- Effect of initial tension and applied loads, Design of members which are curved like crane hook, body of C-clamp, machine frame etc., Design of power screws like lead screw, screw jack. Design of springs, Design of belt, rope and pulley drive system, selection of chain and sprocket drive systems. Design of gear teeth, Lewis and Buckingham equations, wear and dynamic load considerations, Design and force analysis of different type gears. Design of Sliding and Journal Bearing.

**Theory of Machines:** Kinematic and dynamic analysis of mechanisms. Cams. Belts and ropes. Chain drive. Friction. Screw jack, pivots, clutches, brakes. Dynamometers. Cams. Governors. Gyroscope. Balancing. Inertia force analysis. Flywheel. Gears. Gear Train.

**Strength of Materials:** Stress and strain in two dimensions, Principal stresses and strains, Mohr's construction, linear elastic materials, isotropy and anisotropy, stress-strain relations, uniaxial loading, thermal stresses. Beams: Bending moment and shear force diagram, bending stresses and deflection of beams. Shear stress distribution. Torsion of shafts, helical springs. Combined stresses, thick-and thin-walled pressure vessels. Struts and columns. Strain energy concepts and theories of failure. Timoshenko beam theory and Kirchoff's plate theory. Introduction to concepts of fracture mechanics. Numerical and Experimental methods, Introduction to Photo-elasticity and strain gauge techniques.

**Engineering Mechanics:** Free body diagrams and equilibrium; trusses and frames; virtual work; kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact.

**Vibrations:** Free and forced vibration of single degree of freedom systems; effect of damping; resonance, Vibration isolation and transmissibility. Two degrees of freedom system. Two degrees of freedom system. Critical speeds of shafts. Many degrees of freedom systems: exact analysis and approximate methods. Vibration of continuous systems: bars, beams, membranes and plates. Nonlinear vibrations: Phase space, singular points, limit cycle; Analytical methods, perturbation techniques, equivalent linearization; Duffing's equation, jump phenomenon, Van der Pol's equation. Stability criterion.

**Finite Element Methods:** One and two dimensional finite element analysis. Method of weighted residuals and variational approach for solving differential equations. Galerkin and Rayleigh-Ritz methods. Finite element method and implementation. Convergence criterion. Finite element formulation for linear elastic continuum. Substructuring. Introduction to dynamic problems.

### **Discipline: Computer Engineering**

#### **Specialization: High Performance Computing System**

**Data Structure & Algorithms:** Recurrence relations, Big-Oh and little-Oh notation, Searching & sorting algorithms; Stack, Queue, Dequeue, singly, doubly and circularly linked list, Tree traversals, AVL Trees, Graph shortest path algorithms, Minimum spanning tree algorithms, BFS and DFS & NP-Complete Problems.

**System Software:** Introduction to system software: compiler, assembler, linker, loader & operating systems; functions of an Editor; Multitasking, Multiprogramming, Timesharing concepts in operating systems.

**Parallel Processing:** Overview of Parallel Processing and Pipelining Processing, study and comparison of uni-processors and parallel processors; Flynn's classification; Classification of pipelining processors, Pipeline Architecture, Study and comparison of processors with and without pipelining. General pipelining reservation table, Pipelining hazards and resolving techniques, Data buffering techniques, Job sequencing and Collision; VLIW (Very Long Instruction Word) processor. Vector and Array Processor, Basic vector architecture, Issues in Vector Processing

**VLSI Design:** Moore's Law, Gadjski Y-Chart, Simple Design Flow and representation of circuits; Data flow and sequencing graph. Basic language concepts in Hardware Description Languages: signals, entity-architecture, concurrent statements, understanding delays and VHDL Programming.

**Cloud Computing:** Introduction to Cloud Computing, Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering & Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS with examples. Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization; Virtualization security management virtual threats, VM Security Recommendations, VM-Specific Security techniques, Secure Execution Environments and Communications in cloud.

**Network & Security:** Introduction to OSI Network Layers; IP address, http, ftp & smtp protocols; Circuit switching, packet switching & multicasting operations. Basics of cryptography: cryptographic hash functions, symmetric and public-key encryption; Internet worms, viruses and spyware. TCP/IP and DNS security.

**Real Time Systems:** Characteristics of Real-Time Systems, Issues in Real-Time Systems, Periodic & Aperiodic Task scheduling in Uniprocessor & Multi-Processor systems; Static & Dynamic scheduling, priority driven, round robin and clock driven scheduling. Resource reclaiming algorithms in Multi-processor Systems.

**Theory of Computations:** Sets and relations; proofs and principles of Mathematical Induction; Recursive definitions, Regular Languages and Regular expressions and Finite Automata.

**Programming Languages:** Data types, control statements, functions, pointers and file handling concepts in C, C++ & Java. Concept and use of Inheritance & Polymorphism; Threading & Exception Handling in Java; String Processing.

## **Discipline: Electrical Engineering**

### **Specialization: Power Systems**

**Fault Analysis:** Positive, Negative and Zero sequence equivalent circuits of lines, two and three winding transformers and synchronous machines. Analysis of shunt and series faults, effect of neutral grounding

**Phase Controlled Converters:** Performance measures of single and three-phase converters with discontinuous load current for R, RL and RLE loads. Effect of source inductance for single and three-phase converters

**Transient Stability:** Equal area criterion and its application to transient stability studies under common disturbances including short circuits. Critical clearing angle and critical clearing time. Numerical solution of swing equation by step-by-step method.

**World energy situation.** Indian energy scene. Comparative study of thermal, hydro, nuclear and gas power plants. Selection and location of power plants. Impact of thermal, gas, hydro and nuclear power stations on environment, air and water pollution, green house effect (global warming), impact on land. Renewable and non-renewable energy sources. Conservation of natural resources and sustainable energy sources.

**Interconnected System:** Merits and demerits, parallel operation of alternators, synchronizing current, power & torque, effect of change of excitation, driving torque & speed of one of the alternators, load sharing and power limit of interconnected stations, voltage, frequency & load control of interconnected stations.

**Characteristics of Electric Motors:** Characteristics of DC motors, 3-Phase induction motors and synchronous motors, Starting and braking of electric motors. Dynamics of Electric Drives: Mechanical system, Fundamental torque equations, components of load torque's, Dynamic conditions of a drive system, Energy loss in transient operations, Steady State Stability, Load equalization

**Static Relays:** Introduction, merits and demerits of static relays. Comparators: amplitude and phase comparator, duality between amplitude and phase comparators. Circulating current type phase-splitting type and sampling type amplitude comparators. Vector product type and coincidence type phase Comparators. (ii) CTs & PTs: Current transformer (CT) Construction, measurement CT and protective CT. Type of potential transformers. Steady state ratio and phase angle errors in CTs and PTs. Transient errors in CT and CVT. Bulk power transmission over long distance, Need for EHV transmission, Problem of EHV transmission power handing capacity and surge impedance loading, Current carrying capacity of conductor, Choice of economic voltage.

**Power System Security:** Introduction to power system security, System monitoring, contingency analysis, System state classification, security control. Automatic Generation Control: Speed governing characteristic of a generating unit. Load sharing between parallel operating generators. Introduction to automatic generation control of an area by computer

**Load Forecasting:** Classification and characteristics of loads, Approaches to load forecasting, Forecasting methodology, Energy forecasting. Problems of AC transmission systems, power flow in parallel paths and meshed system, factors limiting loading capability, stability consideration. Power flow control of an ac transmission line. Basic types of facts controllers. Advantages of FACTS technology

**Voltage Stability:** Power system voltage stability concept, comparison of angle and voltage stabilities, Power system loads, generator P-Q and Q-V characteristics. Voltage collapse. Voltage stability analysis. Methods of improving voltage stability.

**Artificial Neural Networks:** Biological Neuron, Neural Net, Use of neural nets, Applications, Perceptron Model, Idea of single layer and multiplayer neural nets, Back propagation, Hopfield nets, Supervised and unsupervised learning.

## **Specialization: Power Electronics and Electrical Drives**

**Power switching devices overview** – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

**Phase Controlled Converters:** Performance measures of single and three-phase converters with discontinuous load current for R, RL and RLE loads. Effect of source inductance for single and three-phase converters.

**Fundamental of Electrical Drives:** Introduction, Choice of Electrical Drives, Dynamics of Electrical Drives, Concept of Multi-quadrant operation, Components of load torques, Selection of motor power rating, Speed torque, speed control, Starting, Braking.

**State Space Analysis:** Concept of state, state space representation of systems, phase variable form, canonical variable form, physical variable form, Diagonalization, relationship between state equation and transfer function, solution of state equation, concept of controllability and observability, eigen values and eigen vector.

**Non Linear system:** characteristic of nonlinear system, type of non-linearity, jump resonance, limit cycle, describing function method of analysis.

**Stabilized Power Supplies:** Uninterrupted power supplies, online UPS, offline UPS, high frequency online UPS, programmable logic controllers, Voltage stabilizers-servo mechanism, single phase & three phase servo voltage stabilizers.

**Controller Design:** Review of frequency-domain analysis of linear time-invariant systems, concept of bode plot, phase and gain margins, bandwidth, controller specifications, proportional (P), proportional plus integral (PI), proportional plus integral plus integral controller (PID), selection of controller parameters.

**DC Motor Drives:** Starting, Braking and Speed Control, Transient analysis of separately excited motor with armature and field control, Energy losses during transient operation, Phase controlled converter fed DC drives, Dual-converter control of DC drive, Supply harmonics, Power factor and ripple in motor current, Chopper Control DC drives, Source current harmonic in Choppers.

**Power Quality Monitoring:** Monitoring considerations-Historical perspective of power quality measuring instruments-Power quality measurement equipment-Assessment of power quality measurement data-Application of intelligent systems-Power quality monitoring standards Problems of AC transmission systems, power flow in parallel paths and meshed system, factors limiting loading capability, stability consideration. Power flow control of ac transmission line. Basic types of facts controllers. Advantages of FACTS technology

**Converter Circuits:** Rectification and inversion, effect of reactance, six pulse and twelve pulse converter circuits.

**Signal Processing:** Review of Laplace transform, Z transform, Fourier transform. Discrete Fourier transform, Fast Fourier transform, Algorithms and complexity, Introduction to linear optimal filtering.

**Neural Network:** biological neurons and their artificial models-learning, adaptation and neural network's learning rules types of neural networks-single layer, multiplayer-feed forward, feedback networks; back propagation learning and training-Hopfield network.

## **Discipline: Civil Engineering**

### **Specialization: Structural Engineering**

**Structural Analysis:** Basic methods, deflection computations, Energy methods-their applications, analysis of arches, Direct stiffness method, plane stress and plane strain, Basics of Finite element Method

**Numerical methods:** Gaussian elimination method, Interpolation methods, Numerical integration etc.

**Concrete Technology:** Concrete mix design as per IS method. Specifications of superplasticiser and flyash for use in cement concrete. Durability of Concrete-causes of distress, mechanism, preventive measures and test methods. Self Compacting concrete and High strength concrete – production methods and applications.

**Repair and Rehabilitation** of masonry and reinforced concrete structures: Cracks – causes and diagnosis. Materials of repair- cement based, epoxy- properties and applications. Methods of repair and rehabilitation- jacketing, externally bonded plates, shotcrete, special methods for earthquake prone structures.

**Load Computation-** IS specification for dead loads, live loads and wind loads for buildings, roof trusses, bridges and tanks etc. Computation of wind loads on structures and effects.

**Reinforced Concrete Design-** Design of members by limit state method- subjected to flexure, torsion, compression and combined loads including footings and foundations.

Design by working stress method- Circular beam, water tanks including Intze tank, culverts

**Structural Steel design:** Member design of hot rolled sections by limit state method- tension member, compression member, bending member, members subjected to combined loads, plate girder, gantry girder.

Design by working stress method- water tanks (rectangular & cylindrical), design of light gauge and tubular sections.

### **Specialization: Environmental Engineering**

**Water Treatment:** Importance of water, water demand, design flow, design periods, design population, factors affecting water consumption, variation in water demand, quality of water: water quality parameters, water quality requirements, various water treatment methods, method of distributing water, distribution reservoirs, distribution system, distribution system components, capacity and pressure requirements.

**Wastewater Treatment:** Quality parameters, standards of disposal into natural watercourses and on land, collection systems of sewerage, components of sewerage systems, systems of layout, hydraulic design of sewers, construction and testing of sewer line, sewer materials, joints and appurtenances, sewage pumping and pumping stations, maintenance of sewerage system, various methods of sewage treatment, wastewater disposal and reuse.

**Air and Noise Pollution:** Air quality, emission standards, vehicular pollution, effect of air pollution on human health, air pollution modeling, control of gaseous pollutants, noise Pollution, global effect of air and noise pollution, green house effect, acid rain etc.

**Solid Waste Management:** problems associated with solid waste disposal, goals and objectives of solid waste management, classification of solid waste, onsite handling,

storage and processing, solid waste collections, transfer and transport, processing and disposal methods, recovery of resources, conversion, products and energy, industrial solid waste: nature, treatment and disposal methods.

**Hydrology:** evaporation and infiltration, hydrograph analyses, unit hydrograph, fundamentals of ground water flow, Darcy's law, ground water development and ground water pollution.

**Industrial Waste Water Treatment:** Comparative study of industrial waste water with municipal waste water, industrial waste water problems in India, salient feature of water act-1974, air act 1981 and environmental (protection) act 1986, specific industrial treatment processes, neutralization, equalization and proportioning, volume and strength reduction, flow sheet of industrial waste waters generated from various industries.

**Environmental Impact Assessment:** Concepts of EIA, prediction and assessment of impacts on air, water, biota, noise, cultural and socio-economic environment, air quality impact, methods of assessment, litigation of impact, water quality impact, effects of noise on people, cultural and socio economic impacts, EIA of hydro, thermal and nuclear power plants, methodologies for EIA, preliminary assessment, quantification.

### **Specialization: Geotechnical Engineering**

Index properties of soil, classification, pore water pressure, effective stress, permeability, seepage and capillarity. Shear strength, Mohr-Coulomb theory, shear strength of cohesive and non cohesive soil, drainage conditions. Stresses in soil mass due to applied loads. Compaction characteristics, Compressibility of soil, Terzaghi one dimensional consolidation theory, degree of consolidation, compressibility parameters, three dimensional effect on consolidation. Stability analysis of finite and infinite slopes, various methods of analysis, Taylor's stability number. Earth pressure theories and analysis, sheet piles, bulkheads. Bearing capacity of soil, various theories of bearing capacity, analysis and design of shallow foundations and Deep foundation. Analysis and design of embankments dams. Numerical methods in geotechnical engineering. Index and engineering properties of rocks, shear strength and bearing capacity of rocks. Field tests and soil investigation methods.

### **Discipline: Nano-Technology**

#### **Specialization: NANO APPLICATIONS IN MECHANICAL ENGINEERING**

Bulk Nanostructured Materials: Solid disordered Nanostructures – Nanostructured crystals – Nanostructured Ferromagnetism; optical and vibrational spectroscopy; Infrared frequency range – Luminescence – Quantum wells, wires and Dots – Size and dimensionality effects – Excitons – Single electron tunneling – Applications – Superconductivity; Self assembly and catalysis.

Review of the Laws of Thermodynamics and their Consequences, Statistical Description of Systems of Particles, Quantum mechanics Synthesis of Nonmaterial using Chemical methods, Mechanical methods, PVD, CVD, and MOCVD

Characterization Techniques: UV – Visible- NIR - absorption and reflectance Spectroscopy, X- Ray Diffraction studies – Bragg's law – particle size – Scherrer's equation – Photoluminescence (PL) studies – Brillouin spectroscopy – Dynamic Light Scattering (DLS) – NMR Spectroscopy – ESR Spectroscopy – photo electron spectroscopy(XPS)- SEM,TEM,STM,Atomic force microscopy(AFM).Fourier Transform Infrared Spectroscopy (FTIR) – FT Raman studies –Surface Enhanced Infrared spectroscopy, Resonance Raman Spectroscopy,

Sensor & Transducers, Conductometric and capacitive transducers – optical waveguide based transducers – optical fiber based transducers – Interferometric optical transducers – surface plasmon resonance transducers – electrochemical transducers – solid state transducers – pn diodes or bipolar junction based transducers – schottky diode based transducers – MOS capacitor based transducers – FET based transducers –Acoustic wave transducers – Quartz crystal microbalance – Film Bulk acoustic wave resonator (BAW transducer) – Interdigitally launched surface acoustic wave transducer (SAW transducer) – Cantilever based transducers.

Sensor Characteristics and Physical effects: Active and Passive sensors – Static characteristic:- Accuracy, offset and linearity – Dynamic characteristic:- First and second order sensors – Physical effects involved in signal transduction:- Photoelectric effect – photodielectric effect – Photoluminescence effect – electroluminescence effect –chemiluminescence effect – Doppler effect – Barkhausen effect – Hall effect – nernst / Etinghausen effect – Thermoelectric effect – Piezoresistive effect – piezoelectric effect – pyroelectric effect –magneto-mechanical effect (magnetostriction) – Magnetoresistive effect – Faraday-Henry Law –magneto optice Kerr effect – Kerr and Pockels effect.

Nanopolymers – Preparation and characterization of diblock Copolymer based nanocomposites, Nanoparticles polymer ensembles; Assembly of polymer – Nanoparticles composite material; Fabrication of polymer-mediated organized Nanoparticles assemblies; Applications of Nanopolymers in Catalysis.

Theoretical Basics of Carbon Nano tube, Preparation of Carbon Nano-Tubes, Properties of Carbon Nanotubes, Applications of Carbon Nanotubes, Dendrimers

Lithography –Optical lithography – Light sources – photo mask and alignment, Resolution in projection systems – positive and negative photo resists – ultraviolet lithography – X-ray lithography – Synchrotron radiation – Ion beam lithography. Microlithography – Microchips – Electron beam lithography – Ion beam lithography – Maskless lithography – immersion lithography – Semiconductor processing – MEMS design.Nanolithography, Nanosphere lithography – Molecular self-assembly Nanoimprint lithography, Dip-pen nanolithography, soft lithography, Stereolithography, nanoscale 3D shapes – NEMS design. Tools for nanolithography, molecular manipulation by STM and AFM - LB film resists – nanopattern synthesis – Nano scratching.

Introduction to the design of MEMS and NEMS

### **Specialization: NANOMATERIALS IN STRUCTURAL ENGINEERING**

Synthesis of Nonmaterial using Chemical methods, Mechanical methods.

Characterization Techniques, UV – Visible- NIR - absorption and reflectance Spectroscopy, X- Ray Diffraction studies – Dynamic Light Scattering (DLS), Spectroscopy. - SEM, TEM, Atomic force microscopy(AFM).Fourier Transform Infrared Spectroscopy (FTIR). DSC, Thermo Gravimetric analysis.

Sensor & Transducers, Sensor Characteristics and Physical effects, Active and Passive sensors – Static characteristic:- Accuracy, offset and linearity – Dynamic characteristic:- First and second order sensors – Physical effects involved in signal transduction:- Photoelectric effect – photodielectric effect – Photoluminescence effect – electroluminescence effect , Peizo-resistive effect – piezoelectric effect

Nanopolymers – Preparation and characterization, Nano-particles polymer assemblies; Assembly of polymer – Nanoparticles composite material; Fabrication of polymer-mediated organized Nano-particles assemblies; Applications of Nanopolymers in Catalysis.

Yield- Fracture- Rubbery elasticity and viscoelasticity - Composites and nano composites- Surface mechanical properties- Diffusion and permeability- Features of nano composites- Basics of polymer nano composites- Nano reinforcements- Matrix materials.

Theoretical Basics of Carbon Nano tube, Preparation of Carbon Nano-Tubes, Properties of Carbon Nanotubes, Applications of Carbon Nanotubes. Improvement in toughness and fatigue characteristics through incorporation of chemically treated nanotubes into an epoxy. Combination of nanotube based fibres and films. SWNT reinforced fibres etc.

Introduction of nano composites, Properties and features of nano composites, Processing of nano composites, Characterization of nano composites, Applications of nano composites

Nanotechnology in Construction, Cement Science, Concrete Science, Powder Materials Used in Cement Concrete, Poly-carboxylic ether based high range water reducing admixtures for use in concrete, their mechanism and specifications. Concrete and binders modified by nano-particles. Nano Silica and Nano Binders, Capacity and Durability Enhancement with Nano Materials.

Nano Silica and Nano- Cements, Production methods of Nano- Silica (nS), Forms of nS and their Properties, Effects of nS in mortars and concretes, Nano Cement, Commercial Applications

## **Discipline: Computer Application**

### **Specialization: Database Management System**

**Basic Concepts of Data and Database systems:** Data, Fields, Records, Files and Databases, Data modeling for a database, Abstraction and data integration, Three level architecture of a DBMS, Overview of relational, network, hierarchical data models.

**Database Design:** Entity Relationship model, Extended Entity Relationship model. Relational Model & Relational Data Manipulations: Relation, Conversion of ER diagrams to relations, Integrity constraints, Relational algebra, Relational domain & tuple calculus.

**Structured Query Language:** DDL, DML, DCL, Views, Embedded SQL, Indexes, Sequences, Synonyms, Data Dictionary.

**Relational Database Design Concepts:** Functional dependencies, Determining keys, Normalization-1st, 2nd, 3rd, BCNF, 4th and 5th, Lossless join and dependency preserving decomposition.

**Advanced Concepts:** Centralized and Distributed Databases, Security, Concurrency and Recovery. Introduction to Modern Database Systems: Object Oriented Databases, Deductive Database, Spatial Databases, Cloud Databases: SQL, NoSQL and Hybrid, Big Data Fundamentals.

### **Specialization: Software Engineering**

**Software Life Cycle Models:** SDLC Models, Selection of a Life Cycle Model. Software Requirements Analysis and Specifications: Requirements Engineering, Requirements Elicitation, Requirements Analysis, Requirements Documentation.

**Software Project Planning:** Size Estimation, Cost Estimation, Models, Constructive Cost Model, Software Risk Management. Software Design: Design Definition, Modularity, Strategy of Design, Function Oriented Design, IEEE Recommended Practice for Software Design Description, Object Oriented Design.

**Software Metrics:** Software Metrics, Token Count, Data Structure Metrics, Information Flow Metrics, Metrics Analysis. Software Reliability: Basic Concepts, Software Quality, Software Reliability Models, Capability Maturity Model.

**Software Testing:** Testing Process, Functional Testing, Structural Testing, Levels of Testing, Debugging, Testing Tools, Testing Metrics, Automated Testing.

**Software Maintenance:** Maintenance Process, Maintenance Models, Estimation of Maintenance Costs, Regression Testing, Reverse Engineering, Software Re-engineering, Configuration Management.

### **Specialization: Networking & Security**

**Network Fundamentals and Reference Models:** Local Area Networks, Metropolitan Area Networks, Wide Area Network, Layered architectures, Protocol hierarchies, Interface and services: ISO-OSI reference model, TCP/IP reference model, Wireless network, Internetworking.

**Data Communication:** Channel capacity, Transmission media: Twisted Pair, Coaxial and Fibre optic cables, Wireless transmission: Radio, Microwave, Infrared, Millimeter waves, Lightwave transmission, Telephones: Local loops, trunks, multiplexing, switching, narrowband ISDN, broadband ISDN, Communication Satellites - Geosynchronous and low-orbit.

**Error Detection & Correction:** Framing, Error-control, Flow-control; Sliding window protocol; HDLC; Data link layer of internet.

**Internetworking and Switching Techniques:** Switch/Hub, Bridge, Router, Gateways, Concatenated Virtual Circuits, Tunneling, Fragmentation, Firewalls, Circuit switching, Message switching, Packet switching, Routing and Congestion control.

**Application Layer:** File transfer protocol, Electronic mail, World Wide Web, SNMP, STTP.

**Routing Concepts:** Virtual Circuits and Datagrams, Routing Algorithms, Distance Vector Routing-Link State Routing-Inter Domain Routing, Classless Inter-domain Routing, Interior Gateway Routing Protocols, Exterior Gateway Routing Protocol, Border Gateway Protocol, Congestion Control.

**ATM Networks:** Routing in ATM Networks, ATM Address Structure, ATM Routing.

**Network Security:** Attacks, Services and Mechanisms, Security Attacks, Security Services, Integrity check, Digital Signature, Authentication, Hash Algorithms, Cryptography- Public key, Secret key, Domain Name System (DNS), Electronic Mail and World Wide Web, Resource Records, Name Servers, E-mail Architectures and Servers.

## **Discipline: Business Administration**

### **Specialization: Financial Management**

**FOUNDATIONS OF MANAGEMENT:** Management Definition, Evolution of Management, Fundamentals of Planning, Organizing, Staffing, Directing, Leadership,

Controlling.

**BUSINESS MATHEMATICS AND STATISTICS:** Matrices and Determinants, Linear Programming, Role of statistics, Regression, Time series forecasting, Index Numbers, Probability and Probability Distributions, Decision Theory.

**COMPUTER APPLICATIONS IN MANAGEMENT:** Basic Concepts of Computers, Essential Components of computer, Software, Computer networks and Internet, MS-Office, Microsoft Excel, Microsoft PowerPoint, MS Access, MS Project, E-commerce, Applications of Information Technology.

**COMMUNICATION FOR MANAGEMENT:** Introduction, Employment Communication, Oral Communication, Written Communication, Business Letters and Reports, Case Method of Learning, Presentation Skills, Group Communication

**RESEARCH METHODS IN MANAGEMENT:** Introduction, Process of Research, Collection of Data, Quantitative data analysis, Report Preparation

**MANAGEMENT INFORMATION SYSTEM:** Introduction, Role of MIS, Developing MIS Systems, Applications

**ACCOUNTING & FINANCIAL ANALYSIS:** Overview of Accounting concepts, conventions and principles; Mechanics of Accounting, Analysis of financial statement, Funds Flow Statement.

**FINANCIAL MANAGEMENT:** Introduction, Time Value of Money, Risk and Return Analysis, Investment Decision, Financing Decision, Dividend Decision, Overview of Working Capital Decision.

**COST & MANAGEMENT ACCOUNTING:** Introduction, Marginal Costing, Differential Costing and Incremental Costing, Budgeting, Standard Costing, Responsibility Accounting & Transfer Pricing

**SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT:** Overview of Securities, Risk & Return, Securities Markets, Security Analysis, Portfolio theory, Portfolio Management.

**INTERNATIONAL FINANCIAL MANAGEMENT:** Financial Management in a Global Perspective, Foreign Exchange, Foreign Exchange Market, International Monetary System, Balance of Payments, Foreign Direct Investment.

**MANAGEMENT OF FINANCIAL SERVICES:** Financial System, the Reserve Bank of India, Money Market, Management of Financial Services.

**CORPORATE TAXATION:** Introduction to Direct and Indirect Taxes, Nature and Scope of Tax Planning, Corporate Income Tax, Wealth tax, Central Excise Act 1994.

**FINANCIAL DERIVATIVES:** Introduction, Derivative Contracts- Forward, Futures,

Swaps, Options, Risk Analysis and Management.

**BANKING & INSURANCE:** Management of Banks, Banking Functions, Retail banking, High tech Banking, Insurance Services, Indian Insurance Sector, Banks and Insurance services in India

**Specialization: BANKING**

**FOUNDATIONS OF MANAGEMENT:** Management Definition, Evolution of Management, Fundamentals of Planning, Organizing, Staffing, Directing, Leadership, Controlling.

**BUSINESS MATHEMATICS AND STATISTICS:** Matrices and Determinants, Linear Programming, Role of statistics, Regression, Time series forecasting, Index Numbers, Probability and Probability Distributions, Decision Theory.

**COMPUTER APPLICATIONS IN MANAGEMENT:** Basic Concepts of Computers, Essential Components of computer, Software, Computer networks and Internet, MS-Office, Microsoft Excel, Microsoft PowerPoint, MS Access, MS Project, E-commerce, Applications of Information Technology.

**COMMUNICATION FOR MANAGEMENT:** Introduction, Employment Communication, Oral Communication, Written Communication, Business Letters and Reports, Case Method of Learning, Presentation Skills, Group Communication

**RESEARCH METHODS IN MANAGEMENT:** Introduction, Process of Research, Collection of Data, Quantitative data analysis, Report Preparation

**MANAGEMENT INFORMATION SYSTEM:** Introduction, Role of MIS, Developing MIS Systems, Applications

**RISK MANAGEMENT & LIFE INSURANCE UNDERSTANDING:** Risk Management, Exposure Analysis, Check Lists, DOW index, Fault Tree, Event Tree HAZOP studies, safety audit, Introduction to the process of Risk evaluation and concept of Probability, Importance of valuation of a risk, concept of Sum Insured and how to fix the Sum Insured, Introduction to the process of Risk Control, Loss Prevention, Techniques of Risk Retention.

**LEGAL AND REGULATORY ASPECTS OF BANKING AND INSURANCE:** Definition and Sources of Law: Judicial set up in India, Banking & Insurance as a Contract, Doctrines of Banking & Insurance & their Legal Implications. Insurance Act 1938, IRDA Act 1999, Licensing of Brokers, Other Important legislations

**INTERNATIONAL BANKING AND FINANCE:** Evolution of the foreign exchange markets, Methods of payments, International remittance, Concepts and techniques, Remittance in practice, Correspondent banking, Processing clean instruments, Basics of exchange rates, Forward transactions, Basics of merchant rates, Exchange rate arithmetic, Forward contracts & swaps, Financial futures and options, Risk

management in foreign exchange, Financing international trade, The knowledge bank.

**SERVICE MARKETING:** Introduction to services Management, The services marketing triangle, the understanding of Company, Employees and Customers, The services Marketing mix, Four I's of Services, Building customer relationships through segmentation and retention strategies, service recovery; Delivering service.

**RURAL INSURANCE AND MICRO CREDIT:** Rural Insurance: Agriculture(crop insurance) & weather insurance, Agricultural pump set insurance, Insurance of cattle, Insurance of poultry and ducks, live stock insurance, Insurance of micro animals, Re-insurance of agriculture risks. Micro Credit, 3 C's of micro credit, traditional informal micro credit and consumer micro credit, Micro credit lending models, Impact of micro credit on economy, Challenges of micro credit.

**MERCHANT BANKING AND FINANCIAL SERVICES:** Merchant banking, Investment banking Regulation of merchant banking activity, Project preparation and appraisal, Design of capital structure, SEBI guidelines for public issues, Pre issue management, – coordination, marketing and underwriting, post issue management, Security credit rating, Financial Services - Credit Rating - Factoring and Forfeiting - Leasing and Hire Purchasing - RBI guidelines for NBFCs - Credit Cards - Securitization of debts - Housing Finance

**MONEY AND CAPITAL MARKET:** Money market, fixed income or debt market, definition, instruments, call money, Notice money, term money, repos, commercial papers, certificate of deposits, inter-corporate deposits, treasury bills, bonds and securities, government dated securities and debentures, Primary and secondary markets, Organization of the money market, Regulatory framework, Monetary Policy.

**BANKING AND RETAIL FINANCE:** Introduction to Retail Banking, Retail Products and Channels, Types of Retail Banking Products & Services, Recent Trends in Retail Banking, Facilities Management, Emerging New System, Product Management, Sales and Distribution Management, Personal Banking, Securitization, Credit and Risk Management.

### **Specialization: Human Resource Management**

**FOUNDATIONS OF MANAGEMENT:** Management Definition, Evolution of Management, Fundamentals of Planning, Organizing, Staffing, Directing, Leadership, Controlling.

**BUSINESS MATHEMATICS AND STATISTICS:** Matrices and Determinants, Linear Programming, Role of statistics, Regression, Time series forecasting, Index Numbers, Probability and Probability Distributions, Decision Theory

**COMPUTER APPLICATIONS IN MANAGEMENT:** Basic Concepts of Computers, Essential Components of computer, Software, Computer networks and Internet, MS-

Office, Microsoft Excel, Microsoft PowerPoint, MS Access, MS Project, E-commerce, Applications of Information Technology.

**COMMUNICATION FOR MANAGEMENT:** Introduction, Employment Communication, Oral Communication, Written Communication, Business Letters and Reports, Case Method of Learning, Presentation Skills, Group Communication.

**RESEARCH METHODS IN MANAGEMENT:** Introduction, Process of Research, Collection of Data, Quantitative data analysis, Report Preparation.

**MANAGEMENT INFORMATION SYSTEM:** Introduction, Role of MIS, Developing MIS Systems, Applications.

**HUMAN RESOURCE MANAGEMENT:** Human Resources Management, Human Resources Development in India, Strategic Human Resource Management, Human Resources planning, Job Analysis, Recruitment, Selection, Training and Development, Performance Appraisal, Discipline and Grievance Procedures, Industrial Relations.

**TRAINING AND DEVELOPMENT:** Introduction to Training & Development, Performance Appraisal & Training, Training Process, Trainer & Training Institutions, Evaluation of Training

**STRATEGIC HUMAN RESOURCE MANAGEMENT:** Understanding Strategic HRM, Aligning HR systems with business strategy HR Strategy in work force utilization, Strategies for performance and development, Evaluating HR Function, HR Score card.

**LEADERSHIP SKILLS AND CHANGE MANAGEMENT:** The nature and importance of leadership Traits, Motives, and characteristics of leaders, Effective leadership behavior and attitudes, Leadership styles, Developing teamwork, Leadership development, succession and the future, Understanding change, Types of change, Implementing change.

**HUMAN RESOURCE PLANNING:** Introduction, HR planning and corporate strategies, Job analysis, HR Forecasting, Career planning and succession management.

**EMPLOYMENT LAWS:** Trade Unions Act, 1926, Industrial Employment (Standing Orders) Act, 1946, Industrial Disputes Act, 1947, The Payment of Bonus Act, 1965, Employees Provident Funds (and Misc. Provisions) Act, 1952, Workman's Compensation Act, 1923, Employee's State Insurance Act, 1948, Minimum Wages Act, 1948, Payment of Wages Act, 1936, The Contract Labor Regulation and Abolition Act, Factories Act, 1948, Shops & Establishment Act.

**PERFORMANCE MANAGEMENT & RETENTION STRATEGIES:** Performance Appraisal, Behavioral Performance Management, Potential Appraisal & HRD, Performance Planning & Measuring Performance, Competency Analysis and Competency Mapping.

**Specialization: Marketing Management**

**FOUNDATIONS OF MANAGEMENT:** Management Definition, Evolution of Management, Fundamentals of Planning, Organizing, Staffing, Directing, Leadership, Controlling.

**BUSINESS MATHEMATICS AND STATISTICS:** Matrices and Determinants, Linear Programming, Role of statistics, Regression, Time series forecasting, Index Numbers, Probability and Probability Distributions, Decision Theory.

**COMPUTER APPLICATIONS IN MANAGEMENT:** Basic Concepts of Computers, Essential Components of computer, Software, Computer networks and Internet, MS-Office, Microsoft Excel, Microsoft PowerPoint, MS Access, MS Project, E-commerce, Applications of Information Technology.

**COMMUNICATION FOR MANAGEMENT:** Introduction, Employment Communication, Oral Communication, Written Communication, Business Letters and Reports, Case Method of Learning, Presentation Skills, Group Communication.

**RESEARCH METHODS IN MANAGEMENT:** Introduction, Process of Research, Collection of Data, Quantitative data analysis, Report Preparation.

**MANAGEMENT INFORMATION SYSTEM:** Introduction, Role of MIS, Developing MIS Systems, Applications.

**MARKETING IN MANAGEMENT:** Introduction, Concept of Marketing Management, Market Segmentation, Market Targeting, Consumer Behavior, Pricing Decisions, Promotion, A Brief Account of Marketing of Services, Rural Marketing, CRM, Electronic Marketing; B2C, B2B and C2C, Direct Marketing through Internet, International Marketing etc.

**ADVERTISING MANAGEMENT:** Introduction of Marketing Communication and Advertising, Marketing Communication Planning, Advertising objectives and planning, Steps in Advertising Strategies, Media planning & promotion

**RETAIL MANAGEMENT & RURAL MARKETING:** Overview of Retailing Environment and Management, The Customer and Retail Business, Situational Analysis, Choosing a Store Location, Managing Retail Business, Delivering the Product, Rural Marketing

**SALES & DISTRIBUTION MANAGEMENT:** Introduction, Goals in Sales Management, Sales Force Management, Introduction to Distribution Management, Channel Management.

**PRODUCT & BRAND MANAGEMENT:** Introduction to Product Management and market management, Understanding product manager's role and nature of markets, Introduction to Brand Management and Crafting of Brand Elements, Brand as a Concept, Promotion.

**CONSUMER BEHAVIOR & MARKET RESEARCH:** Consumer Behavior, Family Influences on Buyer Behavior, Individual Determinants of Buyer Behavior and Internal Processes, Formation and Modification of Consumer Attitudes, Introduction to Marketing research, exploratory research design, Sources and methods of collecting data.

**MARKETING OF SERVICES:** Introduction to Service Marketing, Service Consumer Behavior, Strategic Issues in Services Marketing, The marketing mix and services, Challenges of service marketing, Service marketing - specific Industries, Tourism, Travel, Transportation service marketing, financial services; Education & Professional service, Telecom & Courier, Media Service.

**Specialization: Information Technology**

**FOUNDATIONS OF MANAGEMENT:** Management Definition, Evolution of Management, Fundamentals of Planning, Organizing, Staffing, Directing, Leadership, Controlling.

**BUSINESS MATHEMATICS AND STATISTICS:** Matrices and Determinants, Linear Programming, Role of statistics, Regression, Time series forecasting, Index Numbers, Probability and Probability Distributions, Decision Theory.

**COMPUTER APPLICATIONS IN MANAGEMENT:** Basic Concepts of Computers, Essential Components of computer, Software, Computer networks and Internet, MS-Office, Microsoft Excel, Microsoft PowerPoint, MS Access, MS Project, E-commerce, Applications of Information Technology.

**COMMUNICATION FOR MANAGEMENT:** Introduction, Employment Communication, Oral Communication, Written Communication, Business Letters and Reports, Case Method of Learning, Presentation Skills, Group Communication.

**RESEARCH METHODS IN MANAGEMENT:** Introduction, Process of Research, Collection of Data, Quantitative data analysis, Report Preparation.

**MANAGEMENT INFORMATION SYSTEM:** Introduction, Role of MIS, Developing MIS

Systems, Applications.

**BUSINESS PROCESS RE-ENGINEERING:** Business process reengineering, BPRE & TQM, Change management, The importance of communication and the resistance to change.

**SYSTEM ANALYSIS AND DESIGN:** Overview of Information System Development, Managing Application Development, Requirement Analysis Structured Analysis, Prototyping, Case Tools, System Design, Output Design, Input Design, Quality Assurance, System Testing and Implementation.

**STRATEGIC MANAGEMENT OF INFORMATION TECHNOLOGY:** Key Issues in Information system & Management, the Role of CEO. Analytical Framework for Strategic IT Initiatives, Sustaining Competitive Advantage of use of IT & Management, I.T. & Intensive Strategic Growth, Creative Learning, Organizational Learning and Role of Information technology in Business Transformation, Information Partnerships, Managing in the Market space- National Information Infrastructure and IT Policy at the National Level, Planning for strategic IT Resource, Managing the IT Function, Outsourcing IT Function.

**DATA BASE MANAGEMENT:** File System and Databases, The Relational Database Model, Entity Relationship Modeling, Normalization, Structured query language, Distributed database management system, Client server systems, Object oriented databases, Web based databases, Database security and administration.

**MANAGEMENT SUPPORT SYSTEM:** Overview of management support systems, Overview of DSS software, Introduction to Data warehousing and development process, Data warehousing applications.

**E-BUSINESS :** Introduction, background and current status, e-business frameworks, e-business design and e-markets, Integrating supply chain management process, Integrating enterprise resource planning process, Selling chain management process, e-CRM processes and their integration, e-banking, e-governance, E-Business strategy into action, Challenges, e-Transition, e-Security.

### **Specialization: General Management**

**FOUNDATIONS OF MANAGEMENT:** Management Definition, Evolution of Management, Fundamentals of Planning, Organizing, Staffing, Directing, Leadership, Controlling.

**ORGANIZATIONAL BEHAVIOUR:** Concept, Perception and Attribution, Attitude, Personality, Learning, Motivation, Group Dynamics, Organizational Power and Politics, Organizational Change, Conflict, Stress, Organizational Culture.

**BUSINESS MATHEMATICS AND STATISTICS:** Matrices and Determinants, Linear Programming, Role of statistics, Regression, Time series forecasting, Index Numbers, Probability and Probability Distributions, Decision Theory.

**MANAGERIAL ECONOMICS:** Introduction to Managerial Economics, Demand Analysis, Supply Analysis, Production functions, Revenue analysis, Market structure and price determination, Pricing Strategies.

**ACCOUNTING & FINANCIAL ANALYSIS:** Overview, Mechanics of Accounting, Analysis of financial statement, Funds Flow Statement.

**COMPUTER APPLICATIONS IN MANAGEMENT:** Basic Concepts of Computers, Essential Components of computer, Software, Computer networks and Internet, MS-Office, Microsoft Excel, Microsoft PowerPoint, MS Access, MS Project, E-commerce, Applications of Information Technology.

**BUSINESS ENVIRONMENT:** Business Environment, Economic environment, Role and functions of RBI, Macroeconomic Schools of thought, National Income Accounting, Balance of payment.

**COMMUNICATION FOR MANAGEMENT:** Introduction, Employment Communication, Oral Communication, Written Communication, Business Letters and Reports, Case Method of Learning, Presentation Skills, Group Communication.

**HUMAN RESOURCE MANAGEMENT:** Human Resources Management, Human Resources Development in India, Strategic Human Resource Management, Human Resources planning, Job Analysis, Recruitment, Selection, Training and Development, Performance Appraisal, Discipline and Grievance Procedures, Industrial Relations.

**FINANCIAL MANAGEMENT:** Introduction, Time Value of Money, Risk and Return Analysis, Investment Decision, Financing Decision, Dividend Decision, Overview of Working Capital Decision.

**COST & MANAGEMENT ACCOUNTING:** Introduction, Marginal Costing, Differential Costing and Incremental Costing, Budgeting, Standard Costing, Responsibility Accounting & Transfer Pricing.

**OPERATIONS MANAGEMENT :** Introduction, Products and Services, Aggregate Production Planning, Facilities Planning, Inventory Management, Maintenance Management, Basic concept of Reliability. Product Quality Management: dimensions of quality, Quality of Design, conformance and performance, Statistical Quality Control, Work Study, Elementary concept on Total Quality Management (TQM), Just

In Time (JIT), Six Sigma, International Quality Certification and other standards, Kaizen and Continuous Improvement, Enterprise resource planning (ERP), Supply chain management (SCM) and collaborative product commerce (CPC), Lean Production and Lean Services.

**RESEARCH METHODS IN MANAGEMENT:** Introduction, Process of Research, Collection of Data, Quantitative data analysis, Report Preparation

**MANAGEMENT INFORMATION SYSTEM:** Introduction, Role of MIS, Developing MIS Systems, Applications.

**MARKETING IN MANAGEMENT:** Introduction, Concept of Marketing Management, Market Segmentation, Market Targeting, Consumer Behavior, Marketing, Pricing Decisions, Promotion, A Brief Account of Marketing of Services, Rural Marketing, CRM, Electronic Marketing; B2C, B2B and C2C, Direct Marketing through Internet, International Marketing etc.

## **Discipline: Energy & Environment**

### **Specialization: Renewable Energy**

#### **1. Energy sources & Availability:**

Conventional, Non-conventional, renewable, non renewable sources of energy, prospects & perspectives & advantages. Introduction to different types of non conventional sources of energy - solar, wind, biomass, OTEC,

geothermal, hydrogen energy, fuel cells, MHD, thermonic convertor, thermo-electric power. Geothermal Energy: Status & estimates, geothermal sources, geothermal systems & their characteristics. Energy form ocean: OTEC System, wave energy devices, Tidal Energy.

## **2. SOLAR ENERGY**

Solar radiation, its measurement and prediction. Flat plate collectors: liquid and air type. Theory of flat plate collectors, advanced collectors, optical design of concentrators, selective coatings, solar water heating, solar dryers. Potential and scope of solar cooling. Types of solar cooling systems, solar collectors and storage systems for solar refrigeration and air-conditioning. Solar Cells : Characteristics new materials for solar cell.

## **3. WIND ENERGY TECHNOLOGY**

Wind Energy: Wind energy potential measurement, general theories of wind machines, basic laws and concepts of aerodynamics, aerofoil design; wind mill and wind electric generator. Description and performance of the horizontal-axis wind machines. Description and performance of the vertical-axis wind machines. Small Wind Turbines: introduction. New methods of harnessing wind energy.

## **4. Biomass Energy :**

Introduction to biomass, biofuels & their heat content, biomass conversion technologies. Aerobic & anaerobic digester, Factors affection biogestion, biogas plants - types & description. Utilisation of biogas - Gasifiers, direct thermal application of Gasifiers. Advantages & problems in development of Gasifiers.

## **5. FUEL CELL TECHNOLOGY**

Fuel Cells. Principle & Classification, types conversion efficiency, polarization & advantages. Description, working principle, components, general performance of AFC, PAFC, SOFC, MCFC. characteristics and comparison.

## **6. POWER PLANT ENGINEERING**

Introduction to economics of power generation. Load duration curves, location of power plants, power plant economics, Indian energy scenario, Levelized cost. Comparison of steam, hydroelectric, diesel and gas turbine power plants.

## **7. NUCLEAR POWER**

Types of nuclear reactors. Heat removal, Reactor collants, Reactor core. Radioactive waste disposal. Economics of nuclear power.