

M.S. (By Research)

MCE111 Civil Engineering

Engineering Mechanics, Construction Materials, Transform Techniques and Partial Differential Equations, Construction Techniques and Practices, Strength of Materials, Fluid Mechanics, Numerical Methods, Environmental Science and Engineering, Applied Hydraulic Engineering, Soil Mechanics, Surveying, Design of Reinforced Cement Concrete and Masonry Structures, Foundation Engineering, Highway Engineering, Structural Analysis, Water Supply Engineering, Design of Steel and Timber Structures, Structural Design, Wastewater Engineering, Ground Improvement Techniques, Irrigation Engineering, Structural Dynamics and Earthquake Engineering, Railways, Airports and Harbour Engineering, Estimating, Costing and Valuation Engineering

MCE121 Geoinformatics

Basic Physics for Remote Sensing - Basic Computer Techniques - Optical, Thermal, Microwave and Hyperspectral Remote Sensing - Plane and Geodetic Surveying - Basics of Photogrammetry - Survey Adjustment - Digital Image Processing - Cartography - Cadastral Survey - Geographical Information System Basics and Applications - GPS Surveying - Total Station Surveying - Open Source GIS - Environment Science and Engineering - Digital Photogrammetry - Satellite Geodesy - Disaster Mitigation and Management - Fundamental and Object Oriented Programming.

MME111 Mechanical Engineering

Foundry Technology-Hot and Cold Working- Forging- Advances in Forming Process-Principles and Applications of Joining Processes- theory of metal cutting- centre lathe and special purpose lathes reciprocating machines, milling machines & gear cutting abrasive process, broaching CNC machine tools and part programming. Machining Processes: Ultrasonic Machining-Abrasive Jet Machining-Water Jet machining-electrical discharge machining and electrical discharge wire cut-Electron Beam, Laser Beam, Ion Beam and Plasma Arc Machining.

Stress, strain and deformation of solids Transverse loading on beams and stresses in beams-Torsion-Deflection of beams-Thin cylinders, spheres and thick cylinders. Basics of mechanisms-Kinematics of linkage and cam mechanisms- Gears and gear trains-Friction. Steady stresses and variable stresses in machine members-Design of shafts and couplings- Design of energy storing elements-Design of bearings and miscellaneous elements. Force Analysis- Balancing- free and forced vibration, mechanism for control.

Jigs and Fixtures. Design of transmission systems for flexible elements- spur gears and parallel axis helical gears- bevel, worm and cross helical gears

Basic concept and first law-second law and entropy-thermodynamic availability- properties of pure substance and steam power cycle- psychrometry. Gas power cycles-air compressor- internal combustion engines and its systems-internal combustion engine fuels, combustion & performance-gas turbines-boilers-steam nozzle-steam turbines-cogeneration and waste heat recovery- Refrigeration and air conditioning. Heat and Mass Transfer: Conduction-convection -radiation-- heat exchangers. Steam and Nuclear Power Plants- Hydel and other power plants.

MME121 *Aeronautical Engineering*

Aircraft Structures - I: Statically Determinate Structures - Statically Indeterminate Structures - Energy Methods - Columns - Failure Theories. Aerodynamics - I: Review of Basic Fluid Mechanics - Two Dimensional Inviscid Incompressible Flow - Airfoil Theory - Subsonic Wing Theory - Introduction to Laminar and Turbulent Flow. Propulsion - I: Fundamentals of Gas Turbine Engines - Subsonic and Supersonic Inlets for Jet Engines - Combustion Chambers - Nozzles - Compressors. Aircraft Systems And Instruments: Aircraft Systems - Airplane Control Systems - Engine Systems - Airconditioning and Pressurizing System - Aircraft Instruments. Aircraft Structures - II - Unsymmetrical Bending - Shear Flow in Open Sections - Shear Flow in Closed Sections - Buckling of Plates - Stress Analysis of Wing and Fuselage. Aerodynamics - II: Fundamental Aspects of Compressible Flow - Shock and Expansion Waves - Two Dimensional Compressible Flow - High Speed Flow over Airfoils, Wings and Airplane Configuration - Special Topics. Propulsion - II: Nozzles for Jet Engines - Ramjet Propulsion - Hypersonic Airbreathing Propulsion - Chemical Rocket Propulsion - Advanced Propulsion Techniques. Aircraft Performance: General Concepts - Drag of Bodies - Steady Level Flight - Gliding and Climbing Flight - Accelerated Flight. Aircraft Stability And Control: Static Longitudinal Stability and Control - Static Directional Stability and Control - Static Lateral Stability and Control - Dynamic Longitudinal Stability - Dynamic Lateral and Directional Stability. Numerical Methods In Fluid Dynamics: Introduction to Numerical Methods in Fluid Dynamics - Derivation of Governing Equation - Boundary Conditions and Mathematical Nature of Fluid Dynamic Equations - Discretization, Stability Analysis and Panel Methods - Numerical Methods for Steady Supersonic Flows. Finite Element Methods: Introduction - Discrete Elements - Continuum Elements - Isoparametric Elements - Field Problem.

MME122 *Automobile / Automotive Engineering*

Front axle types, Front wheel geometry. Condition for true rolling motion. Steering geometry. Ackermann and Davis steering. Types of steering gear box. Propeller shaft. Universal joints. Final drive. Differential-

types. Type of brakes and constructional details. Types of suspension. Independent suspension- front and rear. Rubber, pneumatic, hydro- elastic suspension. Construction and operation of friction clutches. Different types of gear boxes. Fluid couplings and torque converters. Wilson gear box. Hydrostatic drive systems. Electric drive. Continuously Variable Transmission (CVT). Types of car bodies. Classification of bus bodies. Body optimization techniques for minimum drag. Wind tunnel technology. Classification of vibration, definitions. Single degree of freedom, free, forced and damped vibrations. Rolling resistance, cornering properties of tyres. Directional stability of vehicle. Choice of suspension spring rate. Calculation of effective spring rate. Vehicle suspension in fore and aft. Vehicle ride model. Load distribution. Types of Batteries – Principle, Construction. Starting System, D.C. Generators and Alternators. Regulations for charging. Electronic ignition systems. Types of sensors and actuators for automobiles. Microprocessor controlled devices in automobiles. Components for electronic engine management system. PID control. Types of solid state ignition systems and their operation. Fuel control maps, open loop control of fuel injection and closed loop lambda control – Integrated engine control system. Onboard diagnosis system. Emission formation in SI and CI Engines. Effects of design and operating variables. Controlling techniques. Constant Volume Sampling Systems. Measurement techniques of HC, CO, NO_x and Smoke emissions. Dilution Tunnel and Sound level meters. Properties of alcohols, vegetable oils, biogas, natural gas, LPG and hydrogen as engine fuels. Methods of using all the fuels in SI and CI engines. Performance, emission and combustion behavior of the fuels in S.I. and CI engines.

MME123 Manufacturing Engineering

Engineering Materials: Structure and properties of engineering materials and their applications; effect of strain, strain rate and temperature on mechanical properties of metals and alloys; heat treatment of metals and alloys, its influence on mechanical properties.

Applied Mechanics: Engineering mechanics – equivalent force systems, free body concepts, equations of equilibrium; strength of materials – stress, strain and their relationship, Mohr's circle, deflection of beams, bending and shear stress, Euler's theory of columns.

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.

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

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.

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, Computer aided inspection.

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

Manufacturing system modeling and Analysis: Operations research, 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: CAD, CAM, CAPP, CNC, DNC, Robotics, and CIM.

Advances in Manufacturing : Additive manufacturing, cellular manufacturing, FMS, JIT, Lean manufacturing, Agile Manufacturing

MME124 Mechatronics

Micro controller, PLC and Embedded systems: Architecture - CISC and RISC - Addressing modes -

Programming - Timer/counting - Interrupts - Server com of 8081, PIC forming and interaction of 8081, PIC and PLC - Embedded processor - ARM - SHARC - Design and Development - Real time models, languages and operating systems - Task and scheduling - Real time kernel - Communication and synchronization. Robotics, MEMS and Machine Vision Systems: Definitions - Types - Classification - Configuration and control loops - co-ordinate system - kinematics - End effectors - Design - Robot programming - Expert systems - Robotic work cells and applications. Fundamentals - Design and fabrication micro-system - Materials - Fabrication process and micro-system packaging - Micro Devices and materials - classification of nano-structures - Characterization of Nano-materials - Image Acquisition

- Image processing - Image Analysis - Machine Vision Applications. CNC and Automation Techniques: Mechatronic elements in CNC Machine tools - CNC measurement system and tooling - CNC programming

- Testing and maintenance of CNC machines - Fundamentals and concepts in metrology - Inspection and general measurements - Opto electronics in engineering inspection - co-ordinate metrology and quality control - Fluid Power generating / utilizing elements - Control and Regulation elements - Circuit Design - Electro pneumatics and Electronic control of Hydraulic and pneumatic circuits. Sensors, Actuators and Control Systems: Definition - Measurement Techniques - Inductance, capacitance transducer - Piezo electric and magnetic sensors - Radiations and Electro Chemical sensors and Applications - Recent Trends in sensor and Applications - Actuators - Types -Constructions and working principles - Systems and their Representation - Time and Frequency Response - stability of control systems - State variable Analysis and Design - Control system components.

MEE111 Electrical Engineering

RLC circuits - Circuit theorems - Resonance - AC circuits - Star-Delta transformation- Field theorems - Magnetic circuits – Transformers - Equivalent circuit - regulation - Transfer functions - Root locus - Bode Plots - DC machines - Alternators - Induction motor - Digital circuits - OPAMPs - 8 bit Microprocessors - rectifiers - inverters - DC/DC converters - Fourier Transforms - Laplace Transforms - DFT - Transmission line models - Power transfer - Real and Reactive power control - Load flow - Electrical measuring instruments - measuring bridges

MEE121 Control Systems Engineering

MEE122 Instrumentation Engineering

Characteristics of diode, BJT, JFET and MOSFET - Transistors at low and high frequencies, Amplifiers, single and multi-stage - Feedback amplifiers - Operational amplifiers, characteristics and circuit

configurations - Instrumentation amplifier - Precision rectifier - V-to-I and I-to-V converter - Op-Amp based active filters - Oscillators and signal generators. Combinational logic circuits, minimization of Boolean functions - IC families, TTL, MOS and CMOS - Arithmetic circuits - Comparators, Schmitt trigger, timers and mono-stable multi-vibrator - Sequential circuits, flip-flops, counters, shift registers. Multiplexer, S/H circuit - Analog-to-Digital and Digital-to-Analog converters - Basics of number system - Microprocessor applications, memory and input-output interfacing-Microcontrollers. Measurements and Transduction: Units and standards - Principle of Transduction - Error and uncertainty analysis - Static and dynamic characteristics of Sensors / Transducers - Resistive, Capacitive, Inductive, Piezoelectric, Magneto-strictive and Hall effect sensors - Measurement of Flow, Level, Temperature and Pressure. Control System: Block-Diagram reduction - Signal Flow Graphs - Time Response - Frequency Response - Root Locus - Routh Hurwitz Criterion - Nyquist Stability Criterion - Lag/Lead Compensators. Process Control: Basics of process control - Continuous and batch processes - Interacting and non-interacting systems - Servo and regulatory operations - Transfer functions and state space models - Characteristic of ON-OFF, P+I+D control modes - Reset windup - PID Controller tuning - Cascade control - Feed-forward control - Final control elements -DCS-PLC. Mass spectrometry - UV, visible and IR spectrometry - X-ray and nuclear radiation measurements - Optical sources and detectors, LED, laser, Photo-diode, photo-resistor and their characteristics - Interferometers, applications in metrology - Basics of fiber optics - Biomedical instruments, EEG, ECG and EMG.

MIC111 *Electronics and Communication Engineering*

Electronic Circuits, Semiconductor Devices, Integrated Circuits, Communication Theory

MIC121 *Computer Science and Engineering*

MIC122 *Information Technology*

Programming, Data structures, Analysis of algorithms, Computer organisation and architecture, Operating systems, Database management systems, Computer networks, Software Engineering, Theory of Computation, Artificial Intelligence.

MTE111 *Chemical Engineering*

Process Calculations and Thermodynamics - Fluid Mechanics and Mechanical Operations - Heat Transfer - Mass Transfer - Chemical Reaction Engineering - Instrumentation and Process Control - Plant Design and Economics - Chemical Technology - Process Modeling

MTE121 *Leather Technology*

Pre Tanning Operations: Hides & Skins - Histological characteristics structure of hides & skins defects - curing & preservation methods - Animal byproducts - soaking, unhairing, liming, deliming, bating, pickling, depickling and degreasing - Their objectives & principles involved. Biochemistry of collagen and other substances - chemicals & auxiliaries used in pre-tanning operations - General pretanning processes of manufacture of different types of heavy and light leathers - Process control in pretanning - Ecofriendly pretanning operations - Physical and chemical testing - Standards and quality control measures in pretanning. By products of animal and tannery operations. Tanning Operations: Tanning materials - Vegetable, mineral and organic - their classification - chemistry & Technology of tanning materials & methods - characterisation manufacture & analysis of various tanning materials. Theory & mechanism of vegetable, chrome, Aluminium, Zirconium, Iron, Titanium, Aldehyde, Oil and other organic tanning. Various unit operations involved in tanning processes their objectives & principles - cleaner processing options - Analysis & characterisation of various types of leathers - Physical and chemical testing - Standards and quality control measures in tanning operations. Post Tanning and Finishing Operations : Retanning, dyeing - fatliquoring and finishing operations - Their objectives & principles - chemicals used for the above unit operations - Syntans, fatliquors, dyes, dye-auxiliaries, pigments, acrylic and protein binders, wax emulsion, fillers, topcoats, NC, CAB lacquers and lacquer emulsions, feel modifiers, their nature & properties in finishing - machinery & methods for post tanning and finishing operations - upgradation methods - chemical and physical properties required for various finished leathers - physical & chemical testing of finished leathers - Tannery Effluent treatment - Effluent treatment plant - Liquid and solid waste management. Leathers & Leather Products: Various types of leathers - upper, sole, garment, leather goods, sports & specially leathers - their characteristics. Leather supplement and synthetics -

Design & manufacture of footwear, leather goods & garments. Leather Economics and Industrial Management - Project feasibility reports - organisation & management of leather sector - marketing & export of leather & products - Machines for leather products manufacture - mechanics & operation - IT applications for leather & product design. Professional Ethics and human values.

MTE131 *Biotechnology*

Composition, structure and properties of Biomolecules, Aqueous chemistry. Enzymes: Mechanism of catalysis and kinetics. Biothermodynamics. Carbohydrate, Protein, Lipid and Nucleic acid synthesis and degradation. Photosynthesis and Oxidative phosphorylation. Central dogma: repair and replication of DNA , transcription and translation.

Anatomy of a cell, Cell components, Membrane, Membrane transport and protein sorting, signal transduction, Structure and function of cytoskeleton, Tissue and their cellular interactions, Cell cycle and cancer.

Immunity, Cells, tissues and organs of the immune system. Antigens, epitopes and antibody reactivity Antibodies: Structure, Classification and Functions, Complement system. Hybridomas and its applications. Organization of immunoglobulin genes and their expression, Antibody diversity B- and T-cells development and cytokines. Antigen processing and presentation-Major histocompatibility complex and their importance. Hypersensitivity and its types.

Structural organization and multiplication of bacteria, viruses, algae and fungi, methods to quantify bacterial growth; Nutritional requirements of bacteria, host-microbe interactions; anti-bacterial , antifungal and anti- viral agents; mode of action and resistance to antibiotics; biofertilizers and biopesticides; microorganism and pollution control; biosensors.

Medium requirements for fermentation processes, medium optimization methods, Stoichiometry of cell growth and product formation , Kinetics of microbial growth, substrate utilization and product formation, Simple structured models, Batch, fed - batch and continuous processes, Mass transfer in bioreactor and Aeration and agitation, Rheology of fermentation fluid, Scale - up concepts.

Polarized light - optical rotation - circular dichroism, UV-VIS Spectroscopy - Applications, nuclear Magnetic Resonance - X -ray diffraction- application in Biology FT-IR, Raman spectroscopy , Theory of chromatography- normal phase & reverse phase chromatography - gel permeation- ion exchange & affinity chromatography

Biological Sequence Analysis, Local and Global Alignment Multiple sequence alignment and Application, Protein structure prediction, Phylogenetics, Biological databases.

MTE141 *Rubber and Plastics Technology*

MTE142 *Polymer Technology*

Polymer Science: Polymers - Classification of polymers - Functionality - Polymerization mechanism - Industrial polymerization techniques - Molecular weight of polymers and their significance - States of aggregation in polymers - Tg - Factors affecting Tg - Crystal nucleation and growth - Spherulite formation - Factors affecting crystallinity. Polymer Materials: Preparation, Structure - Property relationship and applications of General Purpose Rubbers, Special Purpose Rubbers, Polyurethanes and Thermoplastic Elastomers. Preparation, Structure - Property relationship and applications of Commodity Plastics, Engineering Plastics and Specialty polymers. Polymer Testing and Characterization: Test for Processability - Viscosity - Flow characteristics - Vulcanization Tests for rubber. MFI - Gelation and Gel time, Test for Mechanical, Electrical and Optical Properties, Test for durability; Thermal analysis,

Molecular weight studies, Spectroscopic and Morphological studies. Polymer Processing: Flow behavior of Polymers - Compounding and Mixing process, Forming Operations - Extrusion, Injection molding, Blow molding, Compression and Transfer molding, Rotational molding, Thermoforming, Calendaring, Reaction Injection Molding; Latex processing and applications; Composite materials and Fabrication; Polymer recycling. Product and mould design for Polymers: Simple geometries - Spring rates - Creep - Stress relaxation - Design to Specific Spring rates, Rubber under complex loading, Rubber products under dynamic conditions, Property considerations in designing of Plastics Parts, Design of moulds and dies for Rubber and Plastics products

MTE143 *Pharmaceutical Technology*

Unit 1 Biochemistry and microbiology

Cell components, structure and biochemical functions, membrane structure and functions, transport cell membrane, free energy, reduction potential, bioenergetics, electron transport chain, phosphorylation; Classification, physical, chemical properties and metabolism of – Carbohydrates, Lipids, Proteins and amino acids, Nucleic acids, biosynthesis, immunoglobulins. Nomenclature, classification, chemical nature, properties and function of – vitamins, hormones , coenzyme; classification of microbes, bacteriophages, media preparation, different media, growth curve, thermal death kinetics of microbes, sterilization, clinically important microorganisms of bacteria, viruses, fungi, identification and prevention, recombinant engineering – restriction enzymes, vectors, prokaryotic and eukaryotic host systems.

Unit 2 Enzymes and Biochemical Engineering

Enzyme classification, mechanisms, enzyme induction and inhibition, catalysis theories, entropy in catalysis, enzyme kinetics – single substrate reactions, Michaelis – Menten parameters, multi substrate reactions, enzyme immobilization, stoichiometry of cell growth and product formation, elemental balances, degrees of reduction of substrate and biomass, yield coefficients of biomass and product formation, energetic analysis of microbial growth and product formation, oxygen consumption, thermodynamic efficiency of growth, Modes of operation – batch, fed batch and continuous cultivation. kinetic models for microbial growth, Monod model, growth of filamentous organisms; Air Lift Reactor, Bubble Column Reactor, Immobilized enzyme reactors- packed bed, fluidized bed, membrane reactors

Unit 3 Pharmaceutical and analytical Chemistry

Molecular orbital theory and bonding, polar and non-polar bonds, resonance, intramolecular and intermolecular; Atomic and molecular spectra, electronic transitions, Beer and Lambert's law,

Chromophores, Auxochromes, Spectral shifts, Solvent effect on absorption spectra, Principles of vibrational spectroscopy – Instrumentation and sampling technique – Applications in pharmaceutical sciences – NMR principles – Instrumentation – Applications, Thin Layer Chromatography Adsorbents, solvents, elutropic series, uses, limit test, TLC technique, High Performance Liquid Chromatography (HPLC), retention factor, symmetry factor, resolution, theoretical plate, Pharmacopoeial standards and applications – Melting point, boiling point, refractive index, titration curves – acid-base titration, nonaqueous and precipitation titration, iodimetry, iodometry; Argentimetric, redox, and titrations

Unit 4 Pharmaceutics and Formulation

Particle size, shape distribution and measurement, particle number, average particle size, number and weight distribution, sieving, sedimentation, determining surface area, permeability, adsorption, Powders – derived and flow properties, porosity, packing arrangement, densities, bulkiness. Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, free energy, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, surfactants, electrical properties of interface. Newtonian and non-Newtonian systems, thixotropy, viscosity and measurements, colloidal dispersions, suspensions and emulsions, interfacial properties, Brownian movement, flocculation and rheological considerations, emulsions, complexation and protein binding, and drug action. Types of tablets, granulation, coating, hard and soft gelatin capsules characterization, formulation of parenteral products, Sustained release preparations, aerosol formulation.

Unit 5 Pharmacology and chemotherapy

Routes of administration, Pharmacokinetics, Pharmacodynamics, Receptors, Ionization, Drug distribution and pKa values, prodrugs; Classification, mechanism of action, structure activity relationship of various – sympathomimetic agents. adrenergic antagonists, antipsychotics, anticonvulsants, CNS stimulants, opioid analgesics, anti-anginal, vasodilators, calcium channel blockers and cardiac glycosides, anti arrhythmic and anti hyperlipidemic agents eicosanoid drugs, antipyretics, anti-rheumatoid drugs and nonsteroidal anti-inflammatory drugs, Antacids, Adsorbents and protectives, Saline cathartics; Topical Agents – Protectives, Astringents, Anti-microbials topical agent. Chemotherapeutic agents (mechanism of action, structure activity relationship) – sulphonamides, penicillins and cephalosporins, chloramphenicol, macrolides, fluroquinolones, aminoglycosides and tetracyclines; Chemotherapy of tuberculosis, leprosy, fungal, viral diseases, malignancy and immunosuppressive agents

MTE551 Ceramic Technology

Quarrying of ceramic materials, size reduction, mechanical separation, mixing and conveying, powder characterization, Classification of whiteware products, heavy clayware, tests and quality control. Formation and structure of glass, preparation of glass batch, glass melting process, Special glasses, annealing, different types of refractories, different types of cement, concrete, properties of cement and concrete.

MAP111 Architecture

City planning: Evolution and principles of city planning; types of cities & new towns; planning regulations and building byelaws; eco-city concept; Housing: Concept of housing and neighborhood; housing standards, policies and typology, housing infrastructure; housing programs in India; self help housing. Regional planning; settlement system planning; growth of cities & metropolises; rural-urban migration; urban conservation; urban renewal; Traffic and Transportation Planning. History of Architecture: Indian architecture from Indus civilization to Modern contemporary period. European architecture from Egyptian modern architectural styles to contemporary period. Vernacular and traditional architecture. Landscape Design: Principles of landscape design and site planning; history of landscape styles, elements and materials, plant characteristics. Environmental considerations in landscape planning. Computer Aided Design: Application of computers in architecture and planning; understanding elements of hardware and software; computer graphics; programming languages and usage of software packages. Environmental Studies in Building Science - Components of Ecosystem and environment, climate responsive and energy efficient building design. Principles of Building Science - lighting, architectural acoustics etc. Building Services on Water supply, sewerage and drainage systems, electrification of buildings, air-conditioning intelligent buildings; fire fighting systems, building safety and security systems -principles, types, standards and uses; Infrastructure, Services and Amenities in city level planning. Materials and Structural Systems: Behavioral characteristics of all types of building materials; principles of strength of materials; design of structural and principles of disaster resistant structures. Building Construction and Management: Building construction techniques, methods and details; professional practice; project management techniques Development Administration and Management: Planning laws; development control and zoning regulations.