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Lr. No.CR/WSC/ADMISSION-JANUARY 2014 **13.09. 2013**

CIRCULAR

Sub: Syllabus/pattern for the admission of Ph.D./M.S. programmes in January 2014 session

Selection of the candidates will be based on the following criteria

a) 50 marks for the Written test
b) 20 marks for the Interview
c) 20 marks for the Qualifying degree
d) 5 marks for the Experience @ 1 mark for every 2 Years after PG degree
e) 5 marks for Publication in Journal /Conference /Symposium @ 1 mark for each

Cut off mark for the selection is 50 out of 100

Written test and interview : 08.10.2013 (Tuesday) between 9.30 to 10.45am

Number of questions for Test : 50

Duration of the test : 75 min.

Test and interview will be conducted in the University Department/Centre at CEG/ACT/MIT/SAP Campuses of Anna University, Chennai. Interview will be held on the same day or may be extended to the next day, if the number of candidates is more.

Candidates qualified in GATE, NET/SLET/other National Level Eligibility Test or INSPIRE Fellowship of DST, Rajiv Gandhi and Maulana Azad Fellowships of UGC or similar Fellowships awarded by statutory bodies of Govt. of India are exempted from written test and have to appear for interview only.

Candidate has to appear for test and interview in the respective Department/Centre based on their qualifying PG degree for Ph.D. and UG degree for M.S. Separate call letter for written test and interview will be sent by the convenor of the selection committee. No TA/DA will be paid for attending written test and interview.

Syllabus for the written test is given below.

SELECTION LIST WILL BE POSTED IN THE WEBSITE DURING NOVEMBER 2013.

Sd/-
DIRECTOR (RESEARCH)

Syllabus for the admission of Ph.D./M.S. programmes for January 2014

M.S. (By Research)in 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

Urban /Transportation Engineering

Urban Planning, Traffic Engineering and Management, Transportation Planning, Mass Transportation, Highway materials, design and construction, Highway Safety Audit, Environmental Impact Assessment of Transportation Projects and Traffic flow theory.

Structural Engineering

Concrete Structures – Concrete Mix design, Special concrete, Design of reinforced concrete elements, Flat slabs and yield line based design, Inelastic behaviour of concrete structures, Ductile detailing. Dynamics of Structures - Dynamic response of single, two and multi degree freedom systems, Dynamic response of continuous systems, Direct integration methods for dynamic response.Theory of Elasticity and Plasticity – Elasticity solution, Torsion of non – circular sections, Beams on elastic foundations, Plasticity. Finite Element Analysis Axial deformation of bars, Analysis of framed structures, Plates and shells, Applications of finite element for elastic stability, Dynamic analysis, Non-linear vibrational and thermal problems. Experimental Techniques and Instrumentation – Forces and strain measurement, Measurement of vibration and wind flow, Distress measurement, Non destructive testing methods, Model analysis. Steel Structures - Design of members subjected to combined forces, Design of connections, Analysis and design of industrial buildings, Plastic analysis of structures, Design of light gauge steel structures. Earthquake Analysis and Design of Structures – Effects of earthquake on structures, Earthquake resistant design of masonry and RC structures, Vibration control techniques. Design of Bridges – Design of short span and long span bridges, Prestressed concrete bridges, Steel bridges,

Bearings and sub-structures. Analysis and Design of Tall Buildings – Behaviour of various structural systems, Analysis and design of structural elements, Stability of tall buildings, wind effects on structures. Maintenance and Rehabilitation of Structures – Building cracks, Moisture penetration, Distresses and remedies, Strengthening of existing structures. Pre-stressed Concrete - Design of flextural members, Design of continuous and cantilever beams, Design of tension and compression members, Design of composite members. Stability of Structures – Buckling of columns, Beam-columns and frames, Torsional and Lateral buckling, Buckling of plates, Inelastic buckling.

Construction Engineering/Management

Construction Equipment - Construction equipments and management, Equipment for earthwork, Asphalt and Concrete plants, Materials handling equipment. Modern Construction Materials - Special Concretes, Metals, Composites, Waterproofing compounds, Non-weathering materials, Flooring materials and façade materials, Smart and intelligent materials. Project Formulation and Appraisal - Project Formulation, Project Costing, Project Appraisal, Project Financing, Private Sector Participation. Advanced Construction Techniques - Construction of special structures, Cooling towers, Silos, Rehabilitation and strengthening techniques, Demolition techniques. Computer Applications in Construction Engineering and Planning - Optimization techniques, Inventory models, Sceduling application - Sequencing problems – Simulation – Enterprises. Construction Planning, Scheduling And Control - Construction planning, Scheduling procedures and techniques, Cost control, Quality control and safety during construction, Organization and use of project information. Contract Laws and Regulations - Construction contracts, Indian contract act, Torts, Contractual problems, Tamilnadu transparency in tenders act, E-tenders, Arbitration, Legal requirements, Insurance and bonding, Labour acts. Construction Personnel and Project Management - Manpower planning, Organization, Human relations and Organisational behaviour, Welfare measures, Management and development methods, Design and Construction Process, Cost Estimation. Design of Energy Efficient Buildings - Heat Transfer, Thermal Storage, Passive Solar Heating and Cooling, Day lighting and Electrical Lighting, Design for Climatic Zones. Project Safety Management - Construction Accidents, Safety Programmes, Contractual Obligations, Designing for Safety, Owners' and Designers' Outlook. Quality Control and Assurance In Construction - Quality management, Quality systems, Quality planning, Quality assurance and control, Quality improvement techniques. Quantitative Techniques in Management - Operations research, Production management, Financial management, Decision theory, Managerial economics. Resource Management and Control in Construction - Resource planning, Labour management, Materials and equipment, Time management, Resource allocation and levelling. Shoring, Scaffolding and

Formwork - Planning, Site equipment and plant for form work, Pressures on Forms, Design of forms and shores, Forms for domes and tunnels, Slip forms and Scaffolds.

Soil Mechanics and Foundation Engineering/ Rock Engineering And Underground Structures

Stresses in elastic half-space medium by external loads – fundamental solutions –Boussinesq. Flow through porous media – Darcy's law – General equation of flow – steady state condition – solution by flow net – fully saturated conditions. Shear strength of granular sols - Direct shear - Triaxial Testing- Drained and untrained Stress-strain behaviour - Dilation, contraction and critical states - Formation of soils – various soil deposits and their engineering suitability – Genesis of clay minerals – classification and identification – Anion and Cation exchange capacity of clays – specific surface area – bonding in clays. Bearing capacity of shallow foundations - Homogeneous - Layered soils - Soft and Hard Rocks - Evaluation of bearing capacity from insitu tests Function – classification of piles – Factors governing choice of pile foundation – Load transfer principles – piling equipments and methods. Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods - sand piles – concept, design, factors influencing compaction. Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. State of stress in retained soil mass – Earth pressure theories – Classical and graphical techniques – Active and passive cases – Earth pressure due to external loads. Introduction to Geoenvironmental engineering – environmental cycle – sources, production and classification of waste – causes of soil pollution – factors governing soil-pollutant interaction – failures of foundations due to pollutants. Pavements types – Approaches to pavement design – vehicle and traffic considerations – behaviour of road materials under repeated loading – Stresses and deflections in layered systems. Scope and objectives, planning and exploration program, methods of exploration, exploration for preliminary and detailed design, spacing and depth of bores, data presentation. Geophysical exploration and interpretation, seismic and electrical methods.

Environmental Engineering

Environmental chemistry-aquatic chemistry, atmospheric chemistry, soil chemistry-environmental chemicals; Environmental Microbiology - classification and characteristics of Microorganisms-microbes and nutrient cycles- metabolism of microorganisms- pathogens in wastewater- toxicology Fluid flow- continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses- Planning of water system – selection of pipe materials, water transmission main design. Design of sanitary sewer; economics of sewer design-sewer appurtenances; material, construction, inspection and maintenance of sewers. Pollution in wastewaters – physical and chemical

treatment of waste water- Biological treatment of wastewater – sludge treatment and disposal. Design of water and wastewater treatment systems-Principles of treatment-Design of water treatment plants-Design of wastewater treatment plants-Residual management- construction operation and maintenance aspects; Industrial wastewater management, treatment & disposal-Industrial pollution prevention & waste minimization-Industrial wastewater treatment-Wastewater reuse and residual management. Air pollution & control-Meteorology-Control of particulate contaminants-Control of gaseous contaminants-Indoor air quality management-Noise Pollution and Control; Solid and hazardous waste management-Sources, classification and regulatory framework- Waste characterization and source reduction-Storage, collection and transport of wastes-Waste processing technologies-Waste disposal. Industrial wastewater treatment – Impacts of industrial wastewater-classification of industries– industrial pollution, prevention – wastewater reuse and residue management – zero discharge concepts

Environmental Management

Environmental chemistry-aquatic chemistry, atmospheric chemistry, soil chemistry-environmental chemicals; Environmental Microbiology- classification and characteristics of Microorganisms-microbes and nutrient cycles- metabolism of microorganisms- pathogens in wastewater- toxicology. Sustainability and Development Challenges Principles and Frame Work-Sustainable Lively Hood-Sustainable Socio-Economic Systems-Assessing Progress and Way Forward; Environmental Policies and Legislation-Water (P&CP) Act, 1974-Air (P&CP) Act, 1981-Environment (Protection) Act 1986; Environmental Economics-Valuation of Environmental Costs and Benefits-Economics of Pollution Prevention-Economic Instruments for Environmental Protection-Natural Resource Economics. Design of water and wastewater treatment systems-Principles of treatment-Design of water treatment plants-Design of wastewater treatment plants-Residual management- construction operation and maintenance aspects; Industrial wastewater management, treatment & disposal-Industrial pollution prevention & waste minimization-Industrial wastewater treatment-Wastewater reuse and residual management. Air pollution & control-Meteorology-Control of particulate contaminants-Control of gaseous contaminants-Indoor air quality management-Noise Pollution and Control; Solid and hazardous waste management-Sources, classification and regulatory framework- Waste characterization and source reduction-Storage, collection and transport of wastes-Waste processing technologies-Waste disposal. Environmental and socio-economic impact assessment-Components and methods - Socio-economic impact assessment-Environmental management plan-Sectoral EIA; Environmental risk assessment and management-Elements of environmental risk assessment-Tools and methods for risk assessment-Risk management; Environmental management systems and auditing - Environmental management standards Preventive

environmental management-environmental management system-Environmental audit

Water Resources Engineering /Irrigation Water Management

Fluid mechanics – Conservation laws and dimensional analysis - boundary layers and turbulence. Open channel hydraulics. Water supply systems – network analysis. Hydrometeorology – stream flow measurements– hydrographs - Time series analysis – Flood estimation – Flood modeling and management - Droughts and impacts – Drought assessments and management. Hydrogeology – groundwater hydraulics – pumping test analysis – well design and construction – methods of artificial groundwater recharge – regional groundwater modeling and sea water intrusion. Water Resources Systems – optimization techniques. Computational methods in water resources –simulation models – water requirements for crops – soil water relationship – cropping pattern and production practices – Irrigation methods -Irrigation efficiencies – Remote sensing and GIS applications in water resources – digital image processing, basic components of GIS – spatial analysis. Climate change and its impact on water resources and irrigation. Water pollution – water quality management. Principles, design and management of drainage systems. Water shed concepts – soil conservation measures - water harvesting and water conservation. Environmental impact assessment – Types and limitations - Methods of EIA – Environmental management plan. Water and ecosystems – ecological principles – blue, green and gray water concepts – water access and equity – ecosystems management. Linkage between water and health, water and agriculture – legal and regulatory settings- National water policy – IWRM Concepts - Understanding farmers participation - farm economics – financial analysis. - Gender and Water–gender empowerment – gender in development sectors – gender and IWRM – mainstreaming gender in water management - Techniques of data collection analysis and reporting – participatory field research – methods of field research - RRA, PRA tools etc–participatory tools – SPQR and statistical analysis.

Coastal Management/ Ocean Science and Technology

Oceanography – Physical – Chemical - Biological – Geological & Environmental; Coastal Management – Integrated Coastal Management – Stakeholders – Livelihoods & Culture – Institutions - Property & Law – Policy & Governance – Integrated Coastal Management Framework – Integrating Disciplinary Perspectives; Marine Resources – Non-living - Living – Exploration & Exploitation – Management of Coastal & Marine Resources; Coastal Surveying – Cartography – Flow Measurement – Coastal Sediment Transport – Principles of Positioning – Instrumentation - Water Level & Flow Measurements - Wave Properties – Modelling in Coastal Engineering - Remote Sensing & GIS – GIS Data Input Storage and Editing – GIS Analysis – Visual Basic Programming – Map Objects & Customization - Ocean Colour

Sensors & radiometer – Wave Kinematics – Wave transformation – Wave Loads – Wave Properties & Analysis – Coastal Defense – Coastal Hazards – Disaster Management – Shoreline Changes – Coastal Landuse & Landcover Mapping – Coastal Geomorphology; Coastal Hazards — Coastal Environmental Impact Assessment – Components and Methods – Climate Systems – Ocean Currents – Ocean-atmosphere Interactions - Impact of Climate Change – Assessment of Climate Change - Adaptation & Mitigation – Coastal Ecocsystems & Conservation – Coastal Aquaculture – Layout/ Design & Construction – Aquaculture Technologies – Environmental Issues – Engineering and Policies – Ecological Sensitive Areas – Corrosion – Testing – Prevention – Environmental Geochemistry – Continental Environment – Marine Environmental – Environmental Mineralogy – Geochemical Exploration Environment - Coastal Resource Economics – Economics of Coastal Resource Exploitation - Economic Instruments for Environmental Protection - Benefit-cost Analysis/ Valuation of Techniques of Coastal – Trade and Environment - Modelling of Coastal Processes - Hydrogeological Impacts – Groundwater Contamination – Protection – Field Research Methodology – Qualitative Method – Semi Quantitative Methods.

Geoinformatics/Remote Sensing

Physics of Remote Sensing - Data Acquisition - Scattering System - Thermal and Hyper Spectral Remote Sensing - Data Analysis - Basics of Photogrammetry - Geometry of Aerial Photographs - Project Planning, Ground Control and Mosaic - Analogue, Analytical and Digital Photogrammetry - Aero-Triangulation and Terrestrial Photogrammetry - Basics of Cartography – Earth - Sources of Data - Perception and Design - Cartography Abstraction – Basics of GIS - Data Model and Input - Data Analysis and Output - Spatial Modeling - Data Quality and Miscellaneous Topics - Basics of Electronic Surveying - Electromagnetic Waves - Electronic Total Station - Survey Error Analysis and Adjustment - Field Work - Natural Resource Management Applications - Disaster Management & Facility Management Applications - Location Based Services Application - Land Information System & Web GIS Applications - Business, Health and other Applications - Fundamentals and Radiometry - Radar Remote Sensing - Airborne and Spaceborne Radar Systems - Application Of Radar Remote Sensing - Special Topics In Radar Remote Sensing - Basics of Airborne Laser Terrain Mapping – Lidar - Lidar Data Processing - Lidar Mapping and Modeling – Lidargrammetry – Study of different GPS – GPS Data Processing - Basics of Hydrology - Drainage Basin - Areal Assessment - Ground Water and Water Quality - Irrigation and Watershed Management - Ocean Engineering - Ocean General Studies - Coastal Engineering - Remote Sensing Application - Coastal Zone Management - Introduction to Urban Planning - Settlement Mapping - Analysis and Planning - Transportation Planning - Current Trends in

Urban Planning.

Mechanical Engineering/ CAD/CAM/Product/ Industrial Design

Design concepts: Design fundamentals, methods and material selection; Design for Quality; Failure mode effect analysis and design for six sigma; Design of experiments; Statistical consideration and reliability; Introduction to computer graphics fundamentals; Curves and surfaces modeling; Concepts of Solid modeling; Visual realism; Assembly of parts and product data Exchange. Basic concepts of material behavior: Elasticity and plastic behavior of metallic and non-metallic materials. Metallurgical aspects of Materials. Effect of temperature, strain and strain rate on plastic behavior – Super plasticity – .Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps. Selection of metals based on mechanical properties– Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications. Non-metallic materials: Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers; Elasticity: Stress-Strain relations-Equations of equilibrium-compatibility-boundary conditions- three-dimensional stress of a tension generalized hook's law - St. Venant's principle - plane stress - Airy's stress function; Applications of fatigue and fracture mechanics. Mechanics of composite materials and laminated composites. Design of components - Shafts, Gears and Gear Boxes, Brakes, Cam & Follower, flywheel etc. Integrated Design of mechanical systems, for example Elevators, Escalators, Gear Box, Valve gear Mechanisms, Machine Tools. Kinematic and dynamic analysis of mechanisms. Fundamentals of vibration-Harmonic and periodic excitations. Finite Element Analysis related to 1D and 2D problems. Problems of static and dynamic analysis using Finite Element Analysis.

Energy /Thermal/Refrigeration and Air Conditioning/ Internal Combustion Engineering

Conductive Heat Transfer: General 3D heat conduction and its special cases, Extended surfaces, Fin efficiency and effectiveness, Moving Boundary problems, Porous media Heat Transfer.Convective Heat Transfer: Newton's Law of cooling, Forced and Natural Convection, Boundary layer, External and Internal flows, High speed flows. Radiation Heat Transfer: Radiation between black and gray bodies, Shape Factor, Network analogy, Radiation shields, Gas Radiation. Heat Exchangers: Recuperative and regenerative heat exchangers, Compact Heat Exchangers, LMTD Method, NTU Method, Effectiveness, Boiling and condensation, Convective and Diffusion Mass Transfer. Concepts of Energy, Entropy and Exergy – Reversibility and Irreversibility – Principle of increase in Entropy – Entropy Generation –

Availability analysis of simple cycles. Thermodynamic property relations – Maxwell relations, Clausis Clayperon equation, Joule – Thomson efficient. Real Gas behaviour and Multi-Component Systems - Fugacity – Compressibility - Principle of corresponding States. Real gas mixtures, equilibrium in multiphase systems - Gibbs phase rule for non – reactive components. Chemical Thermodynamics and Equilibrium – Thermo chemistry – Adiabatic flame temperature, Criterion for reaction equilibrium, Evaluation of equilibrium composition. Statistical Thermodynamics - Degeneracy of energy levels, Maxwell – Boltzman, Fermi – Diarc and Bose – Einstein statistics. Mass, Momentum and Energy equations and their applications. Potential flow theory – Circulation and Vorticity, Stream and Potential functions, Magnus effect, Kutta – Zhukovsky theorem, Thin Airfoil theory. Viscous flow theory – Laminar and turbulent flow, Poiseuille's equation, Darcy Weisbach equation, Moody diagram. Boundary layer concept – Flow over flat plates, Displacement – Momentum thickness. Compressible fluid flow – Variable area passage, Fanno and Rayleigh Flow - Normal and oblique shock.

Manufacturing Systems Management/Lean Manufacturing/Project Management

Human Resource Management – Management Accounting & Financial Management – Decision Support Systems. Supply Chain Management – Project Management – Six Sigma and Lean Manufacturing. Computer Integrated Manufacturing Systems – Design and Analysis of Experiments – Maintainability Engineering. Design of Cellular Manufacturing System – Flexible Competitive Manufacturing Systems – Manufacturing Planning and Control. Rapid Prototyping – Design for Manufacturing – Advances in Manufacturing Technology

Welding Engineering

Phase diagrams-Iron –Iron carbide diagram-TTT and CCT diagrams- Heat Treatment Techniques-Formation of different microstructural zones in welding of plain carbon steels-heat flow in welding. Welding processes, Weld joints, Weld Symbols, Codes and Standards, Design of Weldments for various loads. Welding of - plain carbon steels-low alloy steels-HSLA steels-Stainless steels and Cast Irons-problems encountered and solutions. Welding of -Aluminium and its alloys-Magnesium and its alloys-Nickel and its alloys-Titanium and its alloys-problems encountered and solutions. Weld defects, Testing of Welds, Failure analysis.

Materials /Metallurgy Engineering

Diffusion in solids, , Strengthening Mechanisms, Phase diagrams, TTT diagrams, CCT diagrams, Heat Treatment of Ferrous and Non-ferrous materials, Surface Hardening. Different Casting Processes,

melting,casting design, Gating & Riser calculations, Directional Solidification, Casting Defects. Different Welding processes, Welding Metallurgy of Ferrous and non- ferrous materials. Theory of plasticity, Fundamentals of Metal forming Cold working & Hot working, Forging & Rolling, Extrusion & Drawing. Metallurgy of Iron and Steel Making, Powder Metallurgy, Ceramics and Composites. Optical Microscopy, X-ray Spectroscopy, Electron Microscopy, Surface Analysis techniques, Atomic force microscopy, Scanning Probe microscopy, Field ion microscopy. Non-Destructive testing – VE, LPT, MPT, IR & Thermal Methods, EDT, Radiography, UT & AE. Failure Analysis – Corrosion failures, Fatigue failures, Wear failures, Creep failure.

Industrial Engineering

Basic Statistics – Probability, LP - TP- Net Works – Queuing - Replacement – Simulation. Work Design: Methods Study – Work Measurement – Ergonomics. Forecasting – Planning – Controlling – Inventory – Layout – Scheduling. SPC – Sampling – TQM – Six Sigma – DOE – Reliability – Maintenance. Programming : Concepts – Logic Development – Syntax

Quality Engineering & Management

Basic Statistics – Probability. LP – TP – Net Works – Queuing – Replacement – Simulation. Forecasting-Planning – Controlling – Inventory – Layout – Scheduling. SPC – Sampling – TQM – Six Sigma – Reliability – Maintenance. Factorial Experiments – Orthogonal Experiments – Roboust Design. Programming : Concepts – Logic Development – Syntax

Computer Integrated Manufacturing /Advanced Manufacturing Engineering

Theory of metal cutting, tool materials, conventional and unconventional machining processes, super finishing processes, high speed machining, tool condition monitoring, tool based micromachining, mechanical micromachining, MEMS based micro-machining, Additive Manufacturing Techniques (rapid prototyping). Plastic deformation, stress strain curves for different materials, work hardening, strain hardening, fatigue, failure analysis, material selection, creep, wear resistance, heat treatment. MMC, PMC, CMC, reinforcements, matrix, interface, volume fraction, weight fraction, processing techniques of different composites, hybrid composites. Measurements, errors, accuracy, precision, calibration, surface roughness, interferometers, Laser metrology, Co-ordinate Measuring Machine(CMM) , in-process inspection, vision system, image processing, Robot classification, end effectors, robot vision, robot programming languages Sensors, transducers, actuators. PLC and artificial intelligence. CNC machines, Automation in Manufacturing, adaptive control, Group Technology, Computer Aided Design /Computer

Aided Manufacturing, Flexible Manufacturing System, Lean manufacturing, RDBMS, Just In Time, Total Quality Management. Finite Element Analysis and Discrete System Simulation. Welding types, HAZ, defects, special casting processes, casting defects, powder metallurgy, metal forming, Electronics manufacturing technology- surface mount technology. Optical microscopy, specimen preparation techniques, TEM, SEM, AFM, Hardness, micro hardness, Impact test. Synthesis of nano materials – Top down and bottom-up approach.

Printing and Packaging Technology

Fundamentals of packaging – FMCG packaging, Bulk Packaging, package design – development, creativity in design, graphic and structural design – software for designing, Brand Management, package performance and testing – Hazards, shock, vibration, compression, cushioning and protective packaging. Package printing processes and security printing, converting & finishing processes; Printing inks and coatings – raw materials, ink types, coating types and specialty coatings, Packaging Materials – Flexible & Rigid polymers, Paper & Board – Manufacturing & Appearance and Performance Properties, Types, Conversion Process & Corrugated Board, Glass, raw materials, types, manufacturing, metals, wood, cloth; Packaging machineries; Testing – mechanical, physical, performance testing, barrier properties, Polymer film – Extrusion – types, properties. Food packaging – aseptic packaging – sterilization – Modified atmosphere packaging – intelligent packaging – active packaging; Healthcare packaging – Packaging line engineering – barcodes – RFID – composite tubes – toxicological investigations; Package designing & shelflife; Closures; Packaging laws & Regulations; Package Cost Estimation; Supply Chain Management & Packaging Environment.

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.

Production /Manufacturing Engineering

Engineering Mechanics, Solid Mechanics, Kinematics of Machines – Design of machine elements – Computer Aided Product Design – Jig fixture and tool designs. Theory of metal cutting – Basic Machining Processes – Special purpose machines – Unconventional/Advanced Machining processes – NC/CNC Machineries. Casting, Welding and metal forming processes – Powder metallurgy – Engineering Materials and metallurgy – Composite materials – NDT methods, casting and welding metallurgy. Inventory management – Plant location and layout – Materials handling – Method, study – work measurement – Break even analysis – Cost accounting – Quality control 0 Control charts acceptances sampling – TQM, TPM. Fluid power automation – Metrology – GT – Automated process planning – FMS – CIM – Robotics - Mechatronics

Aeronautical/ Aerospace Engineering /Avionics

Aeronautical Engineering

Aerodynamics: Introduction to Aerodynamics – Incompressible Flow Theory – Compressible Flow Theory – Airfoils, Wings and Airplane Configuration in High Speed Flows – Viscous Flow and Flow Measurements. Aircraft Structural Mechanics: Bending of Beams – Shear Flow in Open Sections – Shear Flow in Closed Sections – Stability Problems – Analysis of Aircraft Structural Components. Aerospace Propulsion: Elements of Aerospace Propulsion – Propeller Theory – Inlets, Nozzles and Combustion Chambers – Axial Flow Compressors, Fans and Turbines – Rocket and Electric Propulsion. Flight Mechanics: Principles of Flight – Aircraft Performance in Level, Climbing and Gliding Flights – Accelerated Flight – Longitudinal Stability and Control – Lateral, Directional Stability and Control. Finite Element Methods: Introduction – Discrete Elements – Continuum Elements – Isoparametric

Elements – Solution Scheme. Computational Fluid Dynamics In Aerospace Engineering: Numerical Solutions of Some Fluid Dynamical Problems – Grid Generation – Transonic Relaxation Techniques – Time Dependent Methods – Panel Methods.

Aerospace Technology

Aerospace Engineering: Introduction – Aircraft Performance – Stability and Control – Aerodynamics & Propulsion – Aircraft Structures. Electronic Systems: Linear IC's – Digital Systems – Signal Generators – Microcontroller Based Systems – Virtual Instrumentation. Aerospace Structural Mechanics: Bending of Beams – Shear Flow in Open Sections – Shear Flow in Closed Sections – Stability Problems – Analysis of Aircraft Structural Components. Aerospace Propulsion: Elements of Aerospace Propulsion – Propeller Theory – Inlets, Nozzles and Combustion Chambers – Axial Flow Compressors, Fans and Turbines – Rocket and Electric Propulsion. Flight Instrumentation: Measurements Science and Displays – Air Data Instruments and Synchro Transmission Systems – Gyroscopic Instruments – Aircraft Compass Systems & Flight Management System – Power Plant Instruments. Rocketry And Space Mechanics: Orbital Mechanics – Satellite Dynamics – Rocket Motion – Rocket Aerodynamics – Staging and Control of Rocket Vehicles.

Avionics

Digital Avionics: Introduction to Avionics – Avionics System Data Buses, Design and Integration – Avionics System Essentials: Displays, I/O Devices and Power – Packaging – System Assessment, Validation and Certification – Maintenance and Costs of Avionics. Electro Optic System: Introduction – Laser Systems – Infrared Systems – Imaging Devices and Tracking Systems – Fiber Optic Systems. Flight Instrumentation: Measurements Science and Displays – Air Data Instruments and Synchro Transmission Systems – Gyroscopic Instruments – Aircraft Compass Systems & Flight Management System – Power Plant Instruments. NAVIGATION SYSTEM: Navigation System & Inertial Sensors – Inertial Navigation Systems – Radio Navigation – Approach and Landing Aids – Satellite Navigation & Hybrid Navigation. Aerospace Guidance And ConTROL: Introduction – Augmentation Systems – Longitudinal Autopilot – Lateral Autopilot – Missile and Launch Vehicle Guidance. Mathematical Modeling And Simulation: System Models and Simulation – Probability, Concepts in Simulation – System Simulation – System Dynamics and Mathematical Models for Flight Simulation – Flight Simulators as a Training Device and Research Tool. Rocketry And Space Mechanics: Orbital Mechanics – Satellite Dynamics – Rocket Motion – Rocket Aerodynamics – Staging and Control of Rocket Vehicles.

M.S.(By Research)

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.

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, NOx 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.

Plastic/ Polymer Technology

Polymers-Classification of polymers – Functionality – Polymerization mechanism – Industrial polymerization techniques – Molecular weight of polymers and their significance – States of aggregation in polymers – T_g – Factors affecting T_g – Crystal nucleation and growth – Spherulite formation – Factors affecting crystallinity. 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. 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. 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. 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.

Mining Engineering

Classification of drilling methods. Mechanics of percussive and rotary drilling. Diamond drilling – types, barrels and bits. Novel Drilling Techniques for Mining and Construction Industry. Blasting – Explosives

and accessories, Design, patterns of blasting and controlled blasting. Mine Entries: Opening of different size and shape of deposits – Type (shaft, incline or adit), number, location and design. Main haulage drifts and tunnels - purpose, size and location. Sampling methods, pattern spacing of holes, grade and tonnage calculation, applications of geostatistics. Stages of mine planning and preparation of feasibility report. Choice and design of mining methods - Bord & Pillar and longwall workings. Strata behavior and support requirement; exploitation of thick, thin and contigeous coal seams. Working coal seams under water bodies and surface sturctures. Special methods of coal mining – Coal bed methane, coal gassification, hydrulic mining. Classification, selection and design of stoping methods – shrinkage, cut and fill, sub-level, open stoping, VCR, sub-level caving, block caving. Recent trends in mechanization of development and stoping methods. Cyclic and continuous mining systems. Excavation and Loading - Workings, applications and limitations of: Shovels, Draglines, Front-end loaders, Scrapers, BWEs, Surface Miners, etc. Transportation – Working, applications and limitations of: Dumpers, Conveyors, In-pit crushers, High angle conveyors, etc. Waste Dumps and type of formations. Basic rock mechanics: UCS, tensile and shear strength and their time dependent characteristics; failure theories. Stress distributions around single and multiple openings in rocks. Rock reinforcement and rock bursts. Instrumentation. Mine gases; Natural and Mechanical ventilation; Ventilation planning and survey. Ventilation network analysis; Mine fires and explosions; Mine dust and illumination. Meridian – True and Magnetic; Theodolite traverse; Triangulation EDM traversing; Correlation; Modern surveying equipment-Total station and GPS. Pollution control and remedial measures. Preparation and appraisal of EMP, EIA. Environment laws and legislation. Carbon capturing, Green house effect and global warming. Mine reclamation and mine closure planning.

Power Systems /Electrical and Electronics Engineering

Advanced Power System Analysis, Power System Operation and Control, Analysis of electrical Machines, Power System Dynamics, Flexible AC Transmission Systems, Advanced Power System Protection, Restructured Power System, HVDC Transmission

High Voltage Engineering

Electromagnetic fields – Computation and modeling, Transients in Power Systems, High Voltage Generation and measurement, Insulation Technology, High Voltage Testing Techniques, Insulation design, EHV Power Transmission, High Voltage Direct Current Transmission

Power Electronics and Drives /Electrical Machines

Analysis of Electrical Machines, Analysis of Power Converters, Analysis and Design of Inverters, Electromagnetic Field Computation and modelling , Solid State DC Drives, Solid State AC Drives, Special Electrical Machines, Microcontroller and DSP based System Design, Power Electronics for Renewable Energy systems, Power Quality

Embedded Systems Technology

Introduction to Embedded Systems - Case Study: Digital -Basics of building Digital circuits, Asynchronous &Clocked Synchronous circuits, FPGA, Case Study: 8051 Architecture - Architecture of 8 bit microcontroller – memory organization – addressing modes – instruction set Timers - Interrupts - I/O ports, Interfacing I/O Devices- The build process for embedded systems using microcontrollers, Building Embedded Systems-Structural units in Embedded processor , selection of building blocks for embedded processors- memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock- Software Development tools-IDE, assembler, compiler, linker, simulator, debugger, Incircuit emulator, Target Hardware Debugging, Digital Signal-Processing-Introduction to Digital Signal-Processing , Linear Time-Invariant Systems, Decimation and Interpolation The Sampling Process, Discrete Time Sequences, Frequency domain analysis -Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Digital Filters, FIR Filters, IIR Filters, Basics of DS Processor Embedded Networking And Interrupts Service Mechanism-Embedded Networking: Introduction, Microprocessor based system design –Peripheral Interfaces, I/O Device Ports & Buses– Serial Bus communication protocols -RS232 standard – RS485 – CAN Bus – Inter Integrated Circuits (I2C) Device Driver – Introduction to Basic Concept of Parallel port & Serial port Device Drivers, Interrupt sources ,Programmed-I/O busy-wait approach without interrupt service mechanism-ISR concept-– multiple interrupts – context and periods for context switching, interrupt latency and deadline, Data communication for Embedded Systems-Overview of A/D converter, types and characteristics – Sampling , Errors; Building blocks of Automation systems -Calibration, Resolution, Data acquisition interface requirements.–Counters – Modes of operation- Frequency, Period, Time interval measurements, Data Modulation &transmission systems- Time Division Multiplexing (TDM) –Pulse Modulation – Pulse Code Format –Single and Multi channel systems, Introduction to Wired & Wireless communication – IEEE 802.xx Standard-OSI Architecture – Services – basics of AdHoc Network

Control System/ Instrumentation Engineering

Measurements and Transduction: Principle of Transduction - Error and uncertainty analysis - Static and dynamic characteristics of sensors/Transducers - Resistive, capacitive, inductive, piezoelectric,

magnetostrictive and Hall effect sensors – Smart sensors - Measurement of flow, level, temperature and pressure – Measurements in thermal power plant and petroleum refineries. Mathematical Modeling and System Analysis: Lumped and distributed parameter models - Nonlinear system elements - Linearization of nonlinear systems – Transfer functions and state space models – Stability analysis - Controllability and observability – Transfer matrix and state space representation of multivariable systems - Poles and Zeros of MIMO System - Multivariable frequency response analysis - Directions in multivariable systems - Singular value decomposition - Relative Gain Array - System identification - Models for linear time-invariant Systems - Least square estimation - Recursive least square method - Models for time-varying and nonlinear systems. Process ControlP: Basics of process control - Continuous and batch processes – Interacting and non-interacting systems - Servo and regulatory operations - Characteristic of ON-OFF, P, P+I, P+D and P+I+D control modes – Reset windup – PID controller tuning - Cascade control – Feed-forward control - - Adaptive Control Schemes - Multi-loop PID Controller: – Biggest Log Modulus Tuning Method - Decoupling Control - Multivariable PID Controller –Model Predictive Control Schemes.

VLSI Design /Applied Electronics Engineering

Electronic Circuits, Semiconductor Devices, Integrated Circuits, Communication Theory, Digital CMOS VLSI, Analog ICs, Embedded Systems, Advanced Digital Signal Processing, Digital Image Processing, Low Power VLSI

Medical Electronics/Biomedical Engineering

Electronic Circuits, Semiconductor Devices, Integrated Circuits, Communication Theory Biomedical Instrumentation, Biomedical Equipments, Digital Image Processing, Radiological Equipments, Human Assist Devices

Advanced/ Digital/ Optical / Wireless Communication/
Networking Technology/Communication Systems

Electronic Circuits, Semiconductor Devices, Integrated Circuits, Communication Theory Advanced Digital Communication, Wireless Communication, Antenna and Microwave, Fibre Optic Communication, Communication Networks, DSP

M.S. (Research) *in the ECE Depts*

Electronic Circuits, Semiconductor Devices, Integrated Circuits, Communication Theory

Computer Science and Engineering /Software Engineering /

Information Technology /Pervasive Computing

Data Structures and Algorithms, Basics of Probability, Operating Systems, Databases, Computer Architecture, Networking, System Software, Theory of Computation, Web Technology, Programming languages, Software Engineering.

Multimedia Technology

Probability and Statistics: Random Variables, Probability distributions, Correlation, Regression and Testing of Hypothesis. Data Structures and Algorithms: Arrays, Lists, Stacks, Queues, trees, Graphs, Searching and Sorting Algorithms. Graphics and Multimedia: Graphics – Input , Output Devices, Scan conversion – Line Drawing and Circle Drawing algorithms – Clipping, 2 – D and 3-D Transformation – Hidden surface elemination - Text – audio – Image and Video processing – Multimedia Tools. Databases: Relational Databases – Architecture – Query Language – E- R Modeling – Normalization – Query Processing, Transaction Processing – Integrity and Security – Multimedia Data Structures – Queries for Multimedia Databases. Networking: Computer Networks – TCP / IP Model – Physical Layer – Data Link Layer – MAC Protocols – Network Layer – Routing – Addressing – Congestion Control – Transport Layer – Application Layer – Multimedia Communication. Software Development: Programming in C, Object oriented Programming, Software Engineering – Analysis, Design, Coding, Testing and Maintenance, Metrics, Object Oriented Analysis and Design – Operating Systems, Process Management – Scheduling – Deadlocks, Memory Management and File Systems.

Master of Computer Applications (MCA)

Probability and Statistics: Random Variables, Probability distributions, Correlation, Regression and Testing of Hypothesis. Data Structures and Algorithms: Arrays, Lists, Stacks, Queues, trees, Graphs, Searching and Sorting Algorithms. Web Technology and Cloud Computing: Socket Programming , Scripting Languages, Client Server Applications, Database Connectivity – Cloud Computing- Virtulization – Big Data Analytics – NOSQL Data – Data Mining. Databases: Relational Databases – Architecture – Query Language – E- R Modeling – Normalization – Query Processing, Transaction Processing – Integrity and Security. Distributed Databases, Object Oriented Databases – Spatio-Temporal Databases. Networking: Computer Networks – TCP / IP Model – Physical Layer – Data Link Layer – MAC Protocols – Network Layer – Routing – Addressing – Congestion Control – Transport Layer – Application Layer. Security, Cryptography, Symmetric Key and Public Key Algorthims. Software Development: Programming in C, Object oriented Programming, Software Engineering – Analysis,

Design, Coding, Testing and Maintenance, Metrics, Object Oriented Analysis and Design – Operating Systems Process Management – Scheduling – Deadlocks Memory Management, File Systems. Computer Architecture: CPU – Main Memory – Control Unit – I/O Unit – Parallel Processing.

Chemical / Petroleum Refining and Petrochemicals 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

Process Design

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

Industrial Safety Engineering/Fire Engineering and Safety Management

Probability and Reliability - random variable, special distributions, sampling, curve fitting, time series analysis, reliability, computer programming and software, safety in chemical industry - concept of safety and safety auditing, hazardous chemicals-precuations in handling, tolerance limits of industrial emissions, carcinogens-health hazards of insecticides, drinking water standards - computer aided hazards analysis, hazard, risk issues and hazard assessment, instrumentation, testing, risk analysis - environmental pollution control and industrial hygiene, eia, impact assessment and documentation - industrial safety and hazards management - fire and explosion, relief systems, toxicology, leaks and leakages - process simulators - safety in engineering industry - metals and wood working machines, gaurding, welding and gas cutting, cold forming and hot working, finishing, inspection and testing - regulations for health, safety and environment - safety management - construction - safety in material handling - noise and vibration controls - electrical safety - air pollution control - fire and explosive control and transport phenomena.

Environmental Science and Technology

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. Environmental Science - Unit operations and processes

in Environmental Technology - Biological Wastewater Treatment - Separation Processes in Environmental Applications - Air Pollution Control - Solid and Hazardous Waste Management - Modeling of Environmental Systems

Apparel Technology

Measures of Central tendency, Measures of variation and Skewness, Curve fitting, Rank Correlation Sampling and sampling Distribution - AQL Methods, 't' distribution, F distribution, Chi-square distribution Process Control Charts. Production Preplanning Production Systems - Section production systems, UNIT production system, Production scheduling, Network representations. Spreading Machine – Working principle, Features and Technical Specifications of Spreading machines Automatic Cutting Machine Sewing Machine – Special Machines – Button holing, Button fixing, Flat lock, Chain lock, Over lock, Embroidery Sewing machine- Working principle, Special features and attachments Pressing machine Computer Integrated Manufacturing – 3D scanning Technique, Unit Production System. Pattern Engineering – Pattern making, Types of pattern making, Drafting, Standardization of size charts, Pattern details and seam allowances Draping – Dress forms, techniques of draping – Development of basic blocks by the draping method –front, back, sleeves and trouser Flat Pattern Techniques – Dart Manipulation – basic techniques, Applications of dart manipulation Pattern Alteration, /Grading and Layout Planning – Pattern alteration – definition and techniques, Grading –Definition, Principles and types – manual grading and computerized grading. Introduction to Comfort, Thermal Comfort, Body ad Tactile Sensations, Comfort Perception and Preferences, Evaluation of Moisture Comfort and Thermal Comfort, Low stress Mechanical Characteristics

Textile Technology

Fibre Manufacturing - Advances in Man Made Fibres - Fibre Structure Analysis - Frictional Properties - Heat Setting - Mass Variation of Textile Strands - Variance Length Curves and Spectgrogram of Textile Strands - Tensile Properties of Yarn - Mechanism of Fabric Failure - Comfort and Low Stress Mechanical Properties - Fabric Appearance and Other Properties - Dyeing and Finishing - Probability Distribution and Estimations - Analysis of Variance - Process Control and Capability Analysis - Design and Analysis of Experiments

Ceramic Technology

Materials Science - Structure of solids – imperfections – point, line, surface, volume – phase diagrams – Gibbs Phase Rule, single component system , two component system – Diffusion – Fick's Law and its

applications – Properties – Physical, mechanical, electrical, thermal and optical. Traditional Ceramics - Plastic and non plastic raw materials – clay and its types – properties of clay water mixture – size reduction – forming –pressing, extrusion, slip casting – firing. Processing - Powder preparation – powder characterization – modern ceramic processing – sintering Glass- Raw Material – manufacturing – melting – forming – annealing – properties – special glasses. Refractories - Types – acidic, basic, neutral – classification – properties – applications – refractories for special application. Electronic Ceramics- Insulators – dielectric polarization, dielectric strength, dielectric loss, types, properties – capacitors – barium titanate and its types , film capacitors, multilayer capacitors – Piezoelectric – PZT, PLZT, properties – Magnetic – classification, types and properties – fuel cells – sensors. Advanced Ceramic Materials- Properties and Applications – silica, alumina, zirconia, carbides, nitrides Composites- Types – CMC, PMC, MMC, Reinforcements – fibers, whiskers, particles – properties - applications

Leather Technology

Advanced Leather Process Technology and Chemistry - Hides, Skins and Preservation, Structure of Skin and Collagen, Chemistry and Principles involved in Pretanning, Tanning, Post Tanning and Finishing Processes. Specialty Leathers, Cleaner Processing of Leathers, Newer Concepts in Leather Manufacture, Advanced Chemistry and Technology of Leather Chemicals, Science and Technology of Leather Supplements and Synthetics, Colloid and Surface Chemistry of Leather like Surface Tension, Interfacial Tension and Surface Activity, Chemistry and Physics of Collagen, Nano Technology and its Applications in Leather, Engineering Economics in Leather Production, Industrial Safety and Occupational Health in Leather Industries, Energy Management in Leather Industries. Advanced organic and Inorganic Chemistry - Bonding Models, Reaction Mechanisms of Organic Compounds, Different organic reaction types, Chemistry of Transition Metals, Reaction mechanisms of Metal Complexes, Advanced Co-Ordination Chemistry, Concepts in Chemical bonding. Advanced Leather Biotechnology - Microbial Biotechnology, Protein and enzyme chemistry, Molecular Biology, Biochemical Engineering, By-Product Utilisation. Instrumental Methods in Leather Science - Analysis of various Spectroscopic Techniques, Chromatographic Techniques, Applications of Spectroscopic and Chromatographic methods in Leather Science, Electro-analytical Methods, Principles of Microscopic and other Testing Methods in Leather Science. Treatment and disposal of Tannery Waste - Physico-Chemical treatment of Wastewater, Introduction to Biological Treatment of wastewater, Biological Treatment of wastewater, Advanced Wastewater Treatment for the Removal of refractory Organic Compounds, Solid waste Disposal. Environmental Management Systems, Legislations on Environmental Pollution Control and Management,

Clean Development Mechanism (CDM), Occupational Health Hazards and Industries, Environmental Impact Assessment (EIA), Environmental Audit (AE).

Footwear Science and Engineering

Leather Process Technology and Footwear Manufacturing - Technology for Specialty & Non Leather Footwear Manufacturing, Lasting, Good Year Welted Construction, Stitch Down and Other Construction, Sports & Moulded Footwear, Orthopedic, Pedorthic, & Therapeutic Footwear. Mechanics of Machinery, Anatomy and Solid Modeling of Foot - Anatomy of Human Foot, Growth and Deformities, Bio Mechanics, Essentials of Therapeutic Footcare, Solid Modelling, Technology of Footwear Manufacturing, Design and Pattern Development, Cutting, Pre-closing & Closing, Lasting, Post Lasting & Finishing, Footwear Fabrication - Last, Upper Preparation, Bottom Stock Preparation, Lasting and Finishing, Computational Methods and Computer Graphics, Solution of Linear Equation and Interpolation, Two and Three Dimensional Graphics, Gait Analysis, Biomechanics, Corrective Footwear Fabrication Technology, Footwear Machinery - Hand Tools, Upper Making and Unitsole Making Machines for Shoe – Construction, Transport System, Automation in Footwear Machines, Modular Manufacturing and Layout. Footwear Components and Accessories - Components, Grinderies and Chemicals, Fasteners, Accessories, Reinforcements. Footwear Chemicals and Polymers - Polymeric Materials for Footwear Industry, Modifications of Polymeric Materials for Different Footwear Components, Properties, Specific Uses and Testing of different Polymer Materials, Adhesives, Footwear Dressing Chemicals. Computer Aided Design and Manufacture for Footwear - Computer Applications in Footwear Sector, Hardware in CAD, Pattern Engineering, Last Modelling, Advanced Computational Techniques in CAD, Rapid Prototyping, Leather Product Design Methodology and process. Modern Footwear Styling, Historical Evaluation & International Trends, Fashion Considerations, Product Development, Presentation Techniques, Fashion Forecast, Fashion Trend and Forecast Analysis. Organisation and Management of Footwear Sector - Production Management, Marketing Strategy, Personnel Management, Ergonomics and Communication, Ergonomics and Communication, Safety in Footwear Industry Quality Control and Management in Footwear Industries, Operations Research, Industrial Relations and Labour Laws, Total Quality Management.

Biotechnology / Microbial/ Pharmaceutical Technology (with Technology)

Cell Structure and Function of The Organelles - Cell Division and Connection - Transport Across Cell Membrane - Signal Transduction, Signal Amplification and Crosstalk - Classical Genetics - Sex Determination, Sex Linkage and Pedigree Analysis - Structure of Chromosomes and Variation In

Chromosome Structure and Number - Linkage, Crossing Over and Chromosome Mapping In Eukaryotes – Biochemistry - Metabolism of Amino Acids - Protein Transport and Degradation - Metabolism of Nucleic Acids, Polysaccharides and Lipids - Vitamins and Coenzymes – Hormones - Black Box Model - Modeling of Various Fermentation Processes - Design of Fermentation Processes - Bioreactor Design & Construction - Transport Process In Bioreactor - Monitoring of Bioprocesses - Modern Biotechnological Processes - Design and Analysis of Biological Reactors - Introduction To Computational Biology and Sequence Analysis - Phylogenetics - Protein Structure, Modeling and Simulations - Machine Learning, Systems Biology and Other Advanced Topics - Perl For Bioinformatics -Structure of Nucleic Acids and DNA Replication - Transcription and Translation - Regulation of Gene Expression -Cloning and Expression of Genes - Construction of DNA Libraries - DNA Sequencing - PCR and Mutagenesis - Gene Transfer & Gene Therapy – Immunotechnology – Antibodies - Cellular Immunology - Vaccine Technology and Development of Immunotherapeutics

Bio-Pharmaceutical Technology/ Industrial Pharmacy (with Technology)

Generics and its advantages; Biogenerics and Biosimilars, Protein-based biopharmaceuticals, Biosimilars development peptides; Recombinant nonglycosylated proteins; Recombinant glycosylated proteins, Analytical methods for the characterization of biosimilars, Immunogenicity, Case studies: Erythropoietin, Insulin, Somatotropin, Interleukin-2, Interferon Granulocyte- macrophage-CSF. Classification of drugs on the basis of sources, structure, site of action and mode of action, drug metabolism, inactive metabolites, biologically active metabolites, phase I and phase II reactions, prodrugs - Chemistry, Structure property Relationship and properties of drugs having medicinally important compounds - therapeutic applications of anti microbial drugs - biological targets and drugs, Chemistry of Natural products. Foundations of Physiology and Overall Physiology, ANS, CNS, Cardiovascular system, Gastrointestinal system, Muscle and skeletal system, excretory system , Chemical & Physical Foundations – Homeostatic control – neural & endocrine mechanisms – Transport across cell membranes Endocrine control of organic metabolism and growth , Factors effecting drug metabolism , Biotransformation of drugs. Mechanisms of drug absorption - passive and active transport - Routes of drug excretion, clearance; Bioequivalence – Nonlinear pharmacokinetics, Multiple-dose pharmacokinetics; two-compartment open models - equations for multicompartment models; to recognize and use integrated equations to calculate pharmacokinetic parameters; metabolite Pharmacokinetics. Classification of Dosage forms and routes of Administration - Physical and chemical properties of drugs - Solid dosage forms, Liquid Dosage forms, Semisolid Dosage Forms. Novel Drug delivery systems – Transdermal delivery systems, Osmotic drug delivery systems, Liposomes, Nanoparticles.

Pharmacogenetics- pharmacogenomics in drug discovery and drug development.- Expressed sequence Tags (EST) and computational biology, Microbial genomics, computational analysis of whole genomes, computational genome analysis- Viability and ADR in drug response: contribution of genetic factor, Multiple inherited genetic factors influence the outcome of drug treatments - Target identification and validation, Drug candidate identification and optimization. Mutation of drug targets. Basic statistics for clinical trials; Clinical trials in practice; Reporting and reviewing clinical trials; Legislation and good clinical practice -International perspectives; Principles of the International Committee on Harmonisation (ICH)-GCP - Drug development and trial planning - pre-study requirements for clinical trials - Regulatory approvals for clinical trials - Legislative requirements for investigational medicinal products - Project management in clinical trials - Application in clinical trial management; Risk assessment; Research ethics and Bioethics - Principles of research ethics; Ethical issues in clinical trials - animal ethics; Animal rights and use of animals in the advancement of medical technology; Introduction to laws and regulation regarding use of animals in research. Informed Consent and data protection-Data management – Introduction to trial master files and essential documents; Data management. Quality assurance and governance - quality control in clinical trials; Monitoring and audit; Inspections; Pharmacovigilance.

Biotechnology / Bio Engineering/ Molecular Biology/ Human Genetic/ Genomics / Biomedical Science/ Biochemistry (with M.Sc.)

Bioenergetics, Biochemical changes associated with biological processes; Enzyme kinetics and the role of enzymes in metabolism; Classification, biochemical properties, synthesis and metabolism of carbohydrates, proteins and lipids; Structural properties, synthesis and degradation of Nucleic acids. Microscopic examination and classification of microbes; Microbial growth and the medias used; Sterilization techniques; methods to control microbial population; Economical importance of microbes; Mendelian genetics; Sex determination; Disorders linked with chromosomal alterations, Mapping human genes. Cellular organization and functions of prokaryotic and eukaryotic cells; Cell cycle and regulation; Transport processes; DNA structure, Replication and repair; Transcription and translation in prokaryotes and eukaryotes and their regulation; Translation of mRNA in prokaryotes and eukaryotes. Cell signaling principles and the role of receptors in signal transduction; Signal amplification in Oncogenesis; Mutations and cancer; Viral mediated Oncogenesis; Cancer metastasis; Tumor markers and Cancer therapy. Units and abbreviations used in clinical Lab; Collection and preservation of biological samples; Biochemical tests performed for diagnosis; Organ function tests; Recombinant proteins and their clinical applications; Immunotherapy; Gene therapy; Stem Cell therapy. Fundamental

concepts of immunology; Immune responses generated by B and T lymphocytes; Antigen-Antibody interactions; Vaccines; Clinical immunology; Transplantation Immunology.

Microbiology/Botany/Zoology/Biochemistry

Botany

Photosynthesis - Emphasis on mechanisms of electron transport; photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways. Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternative oxidase; photorespiratory pathway. Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis. Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks. Solute transport and photoassimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

Zoology

Developmental biology, Basic concepts of development : Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development. Gametogenesis, fertilization and early development: Production of gametes, cell surface molecules in sperm-egg recognition in animals; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis. Ecology and Evolution. Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations. Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; Spontaneity of mutations; The evolutionary synthesis.

Microbiology

Characterisation, classification and Identification. Morphology,cultivation and reproduction of microbes. Microbial gentics and overview of metabolism. Microbes in relation to disease and health.

Food Processing / Food And Nutritional Biotechnology

Food Chemistry – Composition of foods Nutrient and non-nutrient components of foods, water activity, lipid, carbohydrates, proteins, bioactive components, functional foods, analytical methods in food

analyses; food additives, their functions and applications - Food microbiology - microbial spoilage of foods, food pathogens, food poisoning, food borne infections, microbes in food fermentation. Bioreactor and upstream processing, fermentation processes – batch, continuous, fedbatch, enzymes in food technology, microbial productions of aminoacids, proteins, lipids, flavor components, colouring agents. Types of processing - aseptic processing, drying and ultrafiltration, canning, radiation processing, CAP, MAP, Hurdle technology, newer methods- ohmic heating PEF, High pressure processing, food packaging technology. Cereal, Pulse and oilseed technology, meat, fish and poultry technology, dairy product technology, fruit and vegetable technology, flavours, spices, coffee, tea, cocoa. Heat Transfer, mass transfer, fluid mechanics, mass and energy balance, mechanical operations Engineering materials, pumps, principles of refrigeration, Equipments used for milling, extrusion, mixing, blending, filling, heat processing and cooling. Sensory evaluation of foods, consumer testing, food product development, Assessment of food safety, GHP, GMP, HACCP, sanitation and hygiene in food industry, food safety management systems, ISO. GM foods, use of biotechnology in enhancing food production and safety assessment. Food Laws and regulations – National and international, Codex, JECFA, USFDA, EFSA, FFSAi, BIS. Food economics and Trade, public distribution, food security.

Nano Science and Nano Technology

Physics and Chemistry of Materials - Synthesis of Nanomaterials - Physicochemical Methods For Characterization of Nanomaterials - Imaging Techniques For Nanotechnology - Nanotechnology In Health Care - Lithography and Nanofabrication - Top Down Manufacturing Methods - Nanoelectronics and Sensors - MEMS and Bio MEMS - Advanced Drug Delivery Systems - Biosensors - Nanocomposities

Digital/Landscape /General Architecture

Evolution and principles of city planning; types of cities & new towns; planning regulations and building byelaws; eco-city concept; Concept of housing and neighborhood ; housing standards ,policies and typology , housing infrastructure; housing programs in India; self help housing. settlement system planning; growth of cities & metropolises; rural-urban migration; urban conservation; urban renewal; Traffic and Transportation Planning. Indian architecture from Indus civilization to Modern contemporary period. European architecture from Egyptian modern architectural styles to contemporary period. Vernacular and traditional architecture. Principles of landscape design and site planning; history of landscape styles, elements and materials, plant characteristics. environmental considerations in landscape planning. Application of computers in architecture and planning; understanding elements of hardware and software; computer graphics; programming languages and usage of software packages.

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. 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.

Town and Country Planning

Process of evolution of human settlement planning - Planning systems in India - Type of planning surveys - Sociological and Economic concepts and frameworks - Social and economic Impacts of urban growth and expansion - City-region, urban sprawl, and urban fringe - Current trends in the traffic and transportation development sector in India.- Pedestrian planning- Parking and Public Transport Surveys – Inventory of Transport facilities - Different modes – Private transport – Scope and function of statistics in planning analysis - Distribution and structure of population – Population projection methods - Research processes and planning processes - Access to Information: nature, types and sources - Hypothesis - Housing character and its information with reference to culture and technological changes and development -Impact of industrialization and urbanization on housing and built environment - Green house and eco friendly housing - Housing market and housing finance -Gated community-emergence and management system - Contemporary theories and concepts in city planning - Concept and need for regional planning and regional development – Multi-level planning, block and District planning. Environmental concerns at local, regional and global levels - environmental impact assessment practice in India - Sustainability and environmental - Legislative requirements, public awareness and community participation – Evolution, scope and significance of planning legislation - Review of Town and Country Planning Act of Tamil Nadu - Professional role responsibility and planning consultancy service - project cycle – Planning process and project planning – Funding options for urban development projects - Planning Norms and standards - Basic concepts of government and governance - Governance and urban governance - Urban and rural administration in developed, and developing countries - e-Governance-concepts, theories and practices - e-Readiness indices - Approaches to understanding organizations - Human resource planning and management – Participatory governance - Public relations- Introduction to real property ownership - Real estate investment analysis and portfolio management - Classification of

spatial and non-spatial data application of spatial data in urban and regional plans - Ecotourism - Leisure, recreation and society - Tourist and local community - Tourist site planning- processes and sustainability - Urban development through Five Year Plans - Budgetary allocation from central and state governments for urban development - Asset management - Disaster cycle - Disaster-types, causes and consequences - Disaster preparedness and rehabilitation - Spatial planning and technology interface - Socio-economic and environmental Impact of techno cities - communities and people in building smart cities and smart communities - Information need and the role of web in planning - Web sites and information sources in urban and regional planning.

Electronic Media/ Journalism and Mass Communication/ Visual Communication

Current Affairs: General awareness - Aptitude and mental make-up - Reasoning ability – Divergent thinking - Politics and the nation – Finance and economy – Culture – Famous people – General topics – Major inventions – Poems – Sports – Tourism – Universe - Books and authors - Awards and honours. Media Studies: Nature and process of human communication - Functions of communication - Landmarks in mass communication – Communication theories - Press in India - Films – Television – Advertising - Brand awareness and recall - Public relations - Awareness of Public debates on Matters (polity and economy) – General knowledge - Influencing power equations in the world and their impact on India - International developments - Social history - Understanding of social dynamics. Basic Sciences: Life sciences: Understanding different species - Physical sciences: Understanding of basics of sound, light and motion, etc – Applied sciences: Development in space technologies, etc - Environmental science: understanding of ecology and ecological issues - Health sciences - Scientific discoveries and inventors. Information Technology: Developments in computers – Convergence in technology - Fundamentals of computer hardware and software – Problem-solving and program design – Applications of Information and Communication Technologies (ICTs) – New media – Social Media – Computer graphics and animation. Research Methodology: Research Problem – Objectives – Variables - Sampling – Population – Qualitative Research Methods: Field Observation – Focus Groups – Interviews – Case Studies – Quantitative Methods: Content analysis - Survey Research – Questionnaire - Statistics.

Mathematics

Linear Algebra - Real Analysis - Complex Analysis – Topology - Functional Analysis – Algebra – Mechanics - Ordinary and Partial Differential Equations - Graph theory - Numerical Analysis - Calculus of Variation and Integral Equations - Probability and Statistics

Computer Science Information Technology (with M.Sc.)

Discrete Structures – Computability – Graph – Groups - Computer Arithmetic - Logic Families - Representation of Integers - Programming in C and C++ - Programming in C - Object Oriented Programming Concepts - Relational Database Design and SQL - Data and File Structures - Analysis and Design of Algorithms - Computer Networks - Data Communication – Internetworking – Routing - Network Security - System Software and Compilers - Operating Systems – UNIX - Software Engineering - Current Trends and Technologies - Parallel Computing - Mobile Computing - E-Technologies - Electronic Commerce - Electronic Payment Systems (EPS) - Electronic Data Interchange (EDI) - Digital Libraries and Data Warehousing - Software Agents - Broadband Telecommunications - Main concepts in Geographical Information System (GIS), E-Cash, E-Business, ERP packages - Data Warehousing - Data Mining

Physics/Astrophysics

Vectors and tensors – Second order differential equations and special functions – Partial differential equations – Complex variables – Fourier series, Fourier transform, Laplace transform and Green functions – Group theory – Numerical differentiation and integration – Interpolation – Fixed point analysis of linear and nonlinear differential equations. Numerical solutions of ordinary and partial differential equations. Mechanics of a particle and system of particles – Conservation of laws – Rutherford's scattering formula – Special theory of relativity – Dynamical systems. The Schrodinger equation – Particle in a infinite and finite square well – Harmonic oscillator – Barrier penetration – Hydrogen atom – Perturbation theory and scattering theory. Laws of Thermodynamics – Thermodynamic functions – Maxwell's laws – Phase transitions – Canonical ensembles – Specific heat of ideal gas – Bose – Einstein and Fermi-Dirac statistics – Specific heat of solids. Atomic spectra - Quantum numbers – Fine, Hyperfine structure – LS coupling – Bonding in molecules – Molecular spectra – X-ray spectra – Spontaneous and Stimulated Transitions – Lasers. Nuclear binding energy – Nuclear models – Radioactivity – Decay processes – Nuclear reactions – NMR and MRI – Radiation damage – Radiation detectors – Uses of ionizing radiation – Classification of particles – Particle accelerators – Interaction of radiation with matter. Electrostatics – Gauss's Law – Electric potential – Capacitance and dielectric s-Hall effect – Biot-Savart Law – Ampere's law – Faraday's law – Lenz's law – Eddy currents –Maxwell's equation – Poyntings theorem – Wave equation – Polarization – Diffraction – Interferometry – Optical activity. PN junction diode – MOSFET – LED and LCD – semiconductor laser - Op-amp mathematical operation circuits – analog simulation - oscillators – multivibrators –Digital logic circuits – CMOS logic gates – Combinational and Sequential logic circuits – Memory – Clock circuits – Modulation and

demodulation – Transducers and electronic instruments. Crystal structures – crystallography – Chemical bonding – crystal imperfections – Electron theory of solids – Band theory of solids – Dielectric properties and materials – Clausius – Mosotti equation – Dielectric loss and breakdown – Magnetic materials – Weiss theory – Ferrimagnetism – Superconductivity – Photoconductivity– Ceramic and biomaterials – Nonlinear materials – Shape memory alloys.

Laser and Electro Optical Engineering

Vectors and tensors – probability, random variables, distribution functions – power spectral density – Fourier series, Fourier transform, Fourier analysis, Laplace transform, Dirac delta function – Beta and Gamma functions, Legendre, Bessel, Hermite and Lagurre polynomials - liner and nonlinear oscillators, fixed point analysis, bifurcation and chaos - Numerical differentiation and integration – interpolation – error analysis - numerical methods of solving ordinary differential and partial differential equations. Maxwell's equations – Wave equation in isotropic material – wave equation in anisotropic materials – aniso-tropic materials – index ellipsoid – propagation in uniaxial and biaxial crystals – birefringence – wavel plates and compensators – optical activity. Planar waveguide – TE modes in a symmetric step index planar waveguide – TM modes – relative magnitudes – power – radiation modes – excitation – Maxwell's equations in inhomogeneous media. Optical fiber – numerical aperture – modal analysis for step index and parabolic index medium – multimodes – modes in an asymmetric planar waveguide – Ray analysis – coupled mode theory. Wave equation – linear, circularly and elliptically polarized waves – spatial and temporal coherence – propagation and diffraction of a Gaussian beam. Einstein coefficients-quantum mechanical description of radiating atoms, molecules in gas, liquid & solid phase, selection rules for atoms and molecules, Spectral notation. Condition for producing laser - population inversion, gain and gain saturation - Threshold condition – requirements for obtaining population inversion – 2,3 and 4 level systems – optimum output coupling conditions for CW and pulsed laser action. Resonator as an interferometer – characterization of resonator – resonator stability for Guassian beams – resonator alignment – gain and saturation effects. Concept of Q-switching. Theory of Mode locking and experimental methods. Different types of laser systems – ultrashort pulse generation and measurement – laser matter interaction and laser based materials processing. Energy bands in solids, the E-k diagram, Density of states, Occupation probability, Fermi level and quasi Fermi levels, p-n junctions, Schottky junction and Ohmic contacts. Semiconductor optoelectronic materials, Bandgap modification, Heterostructures and Quantum Wells. Electroluminescence, LED, laser diode and quantum-well lasers. Semiconductor optical amplifiers. Photo detection and detector devices. Optical modulators: Types of modulation – Franz-Keldysh and Stark effect modulators – quantum well electo-absorption modulators.

Optical switching and logic devices: self-electro-optic device. Types of integrated optic circuits - applications of Optoelectronic Integrated Circuits (OEICs) – materials and processing for OEICs – guided wave devices – optical signal processing with OEICs. Growth of single crystals – Electro-optic crystals – acousto-optic crystals – magneto-optic crystals – photorefractive crystals. The electro-optic effect (EOE) - linear and quadratic electro-optic effect – physical properties of electro-optic coefficients. – Bragg diffraction in an anisotropic medium – Raman-Nath diffraction – magneto optic effect – magneto-optic Kerr effect – Franz-Keldysh effect. Electro-optic and acousto optic light modulators - bistable EO devices - Electro-absorption modulators. Optical second harmonic generation – Parametric oscillation. Intensity dependent refractive index –Self-focusing of light and other self-action effects - Optical phase conjugation – Optical bistability and switching - Pulse propagation and temporal solitons. Intensity and polarization based fiber sensors.

Materials Science (with M.Sc)

Atomic Structure and Interatomic Bonding- Structure of Crystalline Solids- Crystal structures – Crystallographic points, directions, and planes – crystal symmetry – point groups and space groups - single crystal and powder X-ray diffraction – theory and experimental techniques – crystal growth - theory and technique – nucleation theory – melt growth – solution growth – vapour growth - Imperfections in Solids – point and line defects. Mechanical Properties of Materials- elastic deformation– dislocations and plastic deformation- Strengthening Mechanisms – Recovery , recrystallization, and grain growth – Failure – ductile fracture – brittle fracture – mechanisms – tensile test - fatigue fracture – creep fracture – mechanisms - hardness – harness testing techniques - Dielectric properties –magnetic properties – optical properties. Characterization of materials – thermal analysis – TGA – DTA , DSC – Microscopic techniques- optical microscopy - electron microscopy - SEM and TEM – Spectroscopy principles and instrumentation. Phase Diagrams –Gibbs phase rule - binary systems – lever rule and its applications – invariant reactions - The Iron–Iron Carbide Phase Diagram - Development of Microstructures - The Influence of Other Alloying Elements - Isothermal Transformation Diagrams - Continuous Cooling Transformation Diagrams - Ferrous Alloys - Nonferrous Alloys – Fabrication of Metals - Heat Treatment of Steels. Structures and Properties of Ceramics- Ceramic structures – ceramic phase diagrams – fabrication and processing of ceramics - Glasses – Glass - Ceramics - Refractories - Advanced Ceramics. Polymers – classification – molecular weight – synthesis – glass transition temperature – viscoelasticity – polymer processing – applications. Composites – types – matrix and reinforcement materials - fabrication of polymer-, metal- , and ceramic-matrix composites. Semiconducting materials: Intrinsic and extrinsic materials, energy band gap – density of states and

dimension of materials – formation of PN junctions – recombination - superconducting materials. Nanoparticles – basic properties – nanotubes, nanowies and nanofibers – synthesis of nanostructure material - nanomaterial characterization.

Medical Physics

Basic Radiation Physics: Atomic Structure, radioisotopes, radioactivity, radioactive equilibrium, artificial radioactivity, production of radioisotopes. Interaction of charged particles with matter, Interaction of X- and gamma rays with matter attenuation, modes of interactions, attenuation and mass energy absorption coefficients, buildup correction, shielding materials. Interaction of neutrons with matter, scattering, absorption, neutron induced nuclear reactions, radioactive capture reactions (n, p), (n, γ), moderation, shielding materials. Basic X-ray Physics characteristics and continuous spectra, basic requirements of medical diagnostic and therapeutic tubes, safety devices in X-ray tubes, technology of modern X-ray tubes, insulation and cooling of X-ray tubes, filtration and beam quality, mobile and dental units,malfunctions of X-ray tubes, limitations on loading, control panels, image intensifiers;technology of electron accelerators. Radiation Quantities and Units w-value, exposure (rate), Kerma (rate), Terma, absorbed dose (rate), activity, energy, rate constants, charged particle equilibrium (CPE), radiation weighting factors, tissue weighting factors, equivalent dose, effective dose, collective effective dose. Radiation Dosimetry Absorbed dose, Kerma, exposure, activity, rate constants, Charged Particle. Equilibrium (CPE), relationship between Kerma, absorbed dose and exposure under CPE; determination of exposure and air kerma, ionization chambers for low, medium and high energy, X-rays and gamma rays, electrometers, determination of absorbed dose. Basic principles of radiation detection, Gas Filled detectors: Ionisation chambers- Theory and design; Construction of condenser type chambers Radiochromic films; Thermoluminescent Dosimeters (TLD), Optically stimulated Luminescence dosimeters (OSLD), radiophotoluminescent dosimeters, neutron detectors, nuclear track emulsions for fast neutrons, solid state nuclear track (SSNTD) detectors, calorimeters. Radiation Measuring & Monitoring Instruments Dosimeters based on condenser chambers, pocket chambers, dosimeters based on current measurement, different types of electrometers-MOSFET, farmer dosimeters, multipurpose dosimeter, water phantom dosimetry systems, brachytherapy dosimeters, Thermoluminescent dosimeter readers for medical applications, calibration and maintenance of dosimeters. Radiation Biology mutations, potentially lethal and sub-lethal damages, modification of radiation damage, LET, RBE, dose rate, dose fractionation, stochastic and deterministic effects of radiation, acute radiation sickness, LD50/60, effects of radiation on skin, blood forming organs, digestive tract and reproductive system; effects of chronic and acute exposure to

radiation, induction of leukemia and radiation carcinogenesis. Nuclear Medicine Clinical radioisotope laboratory and its organization, use of open isotopes including 99Tc in functional studies, measurement of radioactivity, design aspects of collimators, use of whole body counters, physical principles of isotope dilution analysis, circulation time, radioisotope scanners and cameras, cyclotron produced radionuclides, SPECT, PET, radio-Immunoassay (RIA), therapy. Radiation Hazard Evaluation and Control. Radiation monitoring instruments, calibration check of monitoring instruments, radiation monitoring procedures for radiation generating equipment and installations, protective measures to reduce radiation exposures to patients and occupational workers, radiation hazards in radioisotope laboratories, protective equipment.

Chemistry

Stereochemistry – Addition, Substitution and elimination reactions – rearrangements – aromaticity – photochemistry – name reactions – organic qualitative analyses. Atomic structure – hybridization – non-valence forces – Chemistry of d and f block elements – crystal structure – chemistry of co-ordination, organomettalic and bio-inorganic compounds. Thermodynamics – free energy – kinetics – molecular symmetry and group theory – quantum chemistry – electrochemistry – phase equilibria – molecular spectroscopy. Wet chemical methods of analysis –spectral methods – electro analytical techniques – separation techniques – thermal methods of analysis – organic and inorganic quantitative analysis. Polymers – catalysis – corrosion and its control- coatings – fuel/solar cells – membranes – pollution and its control – fibres – Nano chemistry and technology.

Geology

Geomorphology and Remote Sensing. Basic principles. Weathering and soils. Influence of climate on processes. Geomorphology of fluvial tracts, arid zones, coastal regions, 'Karst' landscape and glaciated ranges. Geomorphology of India. Concepts and principles of aerial photography and photogrammetry, satellite remote sensing - data products and their interpretation. Digital image processing. Global and Indian space missions. Geographic Information System (GIS) - principles and applications. Structural Geology and Geotectonics: Principles of geological mapping and map reading, projection diagrams. Stress-strain relationship of materials. Folds, cleavages, lineations, joints and faults and unconformities. Structural behaviour of igneous rocks, diapers and salt domes. Introduction to petrofabrics. Sea floor spreading and plate tectonics. Geodynamics of Indian plates. Stratigraphy and Palaeontology: Nomenclature and modern stratigraphic code. Geological time scale. Stratigraphic procedures of correlation of unfossiliferous rocks. Precambrian stratigraphy of India. Stratigraphy of Palaeozoic,

Mesozoic and Ceinozoic formations of India. Fossil record and geological time scale. Morphology and time ranges of fossil groups. Different microfossil groups and their distribution. Mineralogy and Petrology: Physical, chemical, crystallographic and optical characteristics of common rock forming silicate mineral groups. Structural classification of silicates. The U-stage. Forms, textures and structures of igneous rocks. Binary and ternary phase diagrams. Petrology and geotectonic evolution of granites, basalts, andesites, etc. Origin of magmas. Textures and structures of metamorphic rocks. Metamorphic grades and facies. Metamorphic zones. Sedimentology: Provenance and diagenesis of sediments. Sedimentary textures. Sedimentary structures, palaeocurrent analysis. Sedimentary environment and facies. Tectonics and sedimentation. Classification and definition of sedimentary basins. Sedimentary basins of India. Seismic and sequence stratigraphy. Basin analysis. Geochemistry: Earth in relation to the solar system and universe, cosmic abundance of elements. Composition of planets and meteorites. Structure and composition of earth and distribute of elements. Trace elements. Introduction to isotope geochemistry. Geochemistry of hydrosphere, biosphere and atmosphere. Geochemical cycles and principles of geochemical prospecting. Environmental Geology. Concepts and principles. Natural hazards - preventive/precautionary measures - floods, landslides, earthquakes, river and coastal erosion. Impact assessment of anthropogenic activities. Economic Geology: Indian mineral deposits and mineral economics. Different theories of Ore genesis, Mineral exploration, fundamentals of coal petrology. Indian coal deposits. Origin, migration and entrapment of natural hydrocarbons. Character of source and reservoir rocks. Structural, stratigraphic and mixed traps. Techniques of exploration. Geographical and geological distribution of onshore and offshore petroliferous basins of India. Engineering Geology: Mechanical properties of rocks and soils. Geological investigations for Dams and reservoirs, tunnels, Bridges. Shoreline engineering. Hydrgeology: Origin, Occurrence and Distribution of Water, Well Hydraulics and Well Designing, Groundwater Chemistry, Groundwater Exploration, Groundwater Problems and Management.

Agro Chemistry

Manufacture of Agrochemicals, Resource Management, Pesticide Biochemistry, Pesticides Formulations, Crop Pathology & Pest Management, Weed management, Modern Techniques in agriculture, Food processing, Dairy Technology, Advanced Agrochemicals, Biopesticides and Fertilizers

Agriculture (with M.Sc.)

History and Principles of Plant Pathology, Laboratory and Analytical Techniques, Physiological and Molecular Plant Pathology, Mycology, Plant Bacteriology, Plant Virology, Plant Disease Epidemiology,

Phanerogamic parasites and Non-parasitic Diseases, Fungal Diseases of Crop Plants, Bacterial and Viral Diseases of Crop Plants, Management of Plant diseases

English/Linguistics

Chaucer and The Elizabethan Age: Poetry: Chaucer, Spenser (Allegory), Donne (Metaphysical poetry), Wyatt, Surrey, Sydney. Drama: The Elizabethan world view, Elizabethan theatre, Kyd, Webster, Marlowe, The University. Wits (Lyly, Nash, Peele, Greene, Lodge), Ben Jonson (Comedy of Humours), Middleton, Fletcher, Prose: Bacon, Sir Thomas More; Shakespeare - The Comedies: Much Ado about Nothing, Midsummer Night's Dream, As You Like It, The Merchant of Venice, The Great Tragedies: Macbeth, Hamlet, Othello, King Lear, The Chronicle Histories: Julius Caesar, Henry IV, The Later Comedies: The Winter's Tale, The Tempest, The Sonnets, The Neo Classical Age; Poetry: Milton, Dryden, Pope, Marvell, Goldsmith, Drama: Restoration drama, Goldsmith, Congreve, Sheridan, Novel: Bunyan (Allegorical novel), Richardson, Fielding, Defoe, Swift, Sterne, Smollett, Prose: Addison, Steele, Milton, Swift; Romantic and Victorian Age, Poetry: Wordsworth, Coleridge, Byron, Shelley, Keats, Blake, Arnold, Tennyson, Browning (Dramatic Monologue), Rosetti (Pre-Raphaelite poetry), Burns, Collins, Drama: Shelley, Oscar Wilde, Novel: Austen, Scott, Brontes, George Eliot, Dickens, Hardy, Prose: De Quincey, Lamb, Hazlitt, Ruskin, Carlyle; Twentieth Century Literature, Poetry: Hopkins, Eliot (Modernism), Yeats, Dylan Thomas, Owen (War poetry), Seamus Heaney, Ted Hughes, Thom Gunn, Drama: Shaw, Eliot, Beckett, Synge, Osborne, Ibsen, Brecht, Novel: Joyce (Modernism), Woolf (Stream of consciousness), Conrad, Greene, Lawrence, Prose: Orwell, C.P. Snow; American Literature - Poetry: Whitman, Frost, Emily Dickinson, Sylvia Plath, Stevens, Cummings, Brooks, Drama: O'Neill, Tennessee Williams, Arthur Miller, Sam Shepard, Novel: Poe, Twain, Hawthorne, Melville, Faulkner, Hemingway, Henry James, Alice Walker, Prose: Emerson, Thoreau; Post Colonial Literatures in English, Canadian Literature: Atwood, F.R. Scott, Australian Literature: Patrick White, A.D.Hope, Judith Wright, African Literature: Ngugi, Soyinka, Achebe, Gordimer, West Indian Literature: Derek Walcott, V.S. Naipaul; Indian Literature in English, Poetry: Sarojini Naidu, Toru Dutt, Derozio, Tagore, Ezekiel, Ramanujan, Kamala Das, Parthasarathy, Pritish Nandy, Kolatkar, Eunice d'Souza, Gauri Deshpande, Mahapatra, Drama: Tagore, Karnad, Tendulkar, Badal Sircar, Dattani, Manjula Padmanabhan, Novel: R.K.Narayan, Raja Rao, Mulk Raj Anand, Anita Desai, Shashi Deshpande, Bhabani, Bhattacharya, Anil Joshi, Manohar Malgonkar, Khushwant Singh, Amitav Ghosh, Shashi, Tharoor, Vikram Seth, Arundhati Roy, Prose: Vivekananda, Tagore, Gandhi, Nehru, Aurobindo, Radhakrishnan, Meenakshi Mukherjee, Coomaraswamy; English Language, Linguistics and ELT, History of English Language, Features of Natural Language, Levels of Linguistic Analysis: Phonetics, Phonology, Morphology, Syntax, Semantics,

Discourse Analysis, Pragmatics, Phrase Structure Grammar, Transformational Generative Grammar, Deep and Surface Structure, Sociolinguistics: Language Varieties, Language and Society, Language and Culture, ELT: Methods and Approaches, Grammar Translation Method, Audiolingual Method, Community, Language Teaching, Silent Way, Suggestopedia, Total Physical Response, Communicative Language Teaching, Behaviourism, Cognitivism, Humanism, Learning theories, Second language Acquisition theories, Language Testing; Literary Criticism and Literary Theory - Classical Criticism: Plato, Aristotle, Longinus, Horace, Criticism before 20th century: Sydney, Dequincey, Dryden, Keats, Arnold, Modern Criticism: Structuralism, Deconstruction, Cultural Criticism, Post-Marxism, Cultural Materialism and New Historicism, Post-colonialism, Hermeneutics and Reader-Oriented Criticism, Feminist Criticism, Ecocriticism, Indian Poetics: Rasa and Dhvani, Tamil poetics, Tholkappiyam

Master of Business Administration with any specialisation

General Management and Business Research : Evolution of Management Thought – Managing globally – Planning – MBO – Decision making – Organizing – Departmentation – Directing – Controlling. Types of Research – Research Process – Research Problem – Research objectives – Research hypotheses – Research Design – Measurement and scaling – Types of data – Data collection – Construction of questionnaire and instrument – Validation of questionnaire – Sampling – Data Preparation – Data Analyses – Statistical techniques – Research report – ethics in research. Marketing Management : Marketing Environment – Marketing Planning Process – Marketing Mix Elements – Segmentation, Targeting, Positioning – Strategic marketing – Customer Relationship Management – Marketing Information System – Marketing Research – Recent Marketing Trends. Organizational Behaviour and Human Resource Management : Organizational behaviour – Behaviour modification - Personality - Misbehaviour management – Emotions - Emotional intelligence - Perception – attitudes – values - Motivation – Communication – Group behaviour – interpersonal relations - Power – politics - Teams – leadership –Organizational development – Gender sensitive workplace - Organizational climate - change - Culture – Stress – Organizational effectiveness. Evolution of Human Resource Management — sources of HR - Recruitment – Induction – Socialisation - HR Planning – Selection – Training & Executive development – Performance measurement – Career management - worklife balance - Grievance - redressal mechanism -Inclusive growth - Affirmative action. Operations Management : Demand forecasting - Capacity planning – Aggregate Planning - Product Design - Vendor rating and Value analysis. Project Management – Scheduling Technique, PERT, CPM; Scheduling - shop floor control; Flow shop scheduling - Quality – Vision, mission and policy statements. Customer Focus – customer perception of quality, dimensions of product and service quality. Cost of quality. Concepts of

quality circle, Japanese 5S principles. Six sigma – concepts of process capability - Quality functions development (QFD) – Benefit, Voice of customer, information organization, House of Quality (HOQ), building a HOQ, QFD process, Failure mode effect analysis (FMEA) – FMEA stages, design, process and documentation. Seven Tools, Bench marking and POKA YOKE. Systems Management : Introduction – Information Technology, Information system, evolution, types based on functions and hierarchy, System development methodologies, SAD Tools, DBMS – Functional Information Systems, DSS, EIS, KMS, GIS, International Information, ERP, System Data warehousing and Data Mart. Security, Testing, Error detection, Controls, IS Vulnerability, Disaster Management, Computer Crimes, Securing the Web, Intranets and Wireless Networks, Software Audit, Ethics in IT, User Interface and reporting, Cloud computing. Financial Management: Time value of Money, Risk and return concept – Capital Budgeting – Evaluation Techniques – Capital rationing, Cost of Capital, Measurement of specific cost and overall cost of capital, Capital Structure, Designing capital structure, Financial and operating leverages – Dividend Policy, Forms of dividends, Share splits, Working capital Management, Determinants, working capital finance. Export and Import Finance – FOREX Management – Documentation in Exports and Imports – Corporate Governance – Provision of Company's Act – SERA – FEMA-SEBI guidelines.