ANNEXURE-III

SCHEME AND SYLLABUS FOR RECRUITMENT TO THE POST OF LECTURERS IN GOVERNMENT POLYTECHNICS IN TECHNICAL EDUCATION SERVICE

SCHEME OF EXAMINATION

Written Examination (Objective Type)		No. of Questions	Duration (Minutes)	Marks
Paper – I	General Studies and General Abilities	150	150	150
Paper – II	Concerned Subject	150	150	300
TOTAL MARKS				**450**

Name of the Papers	Language of Examination
Paper-I: General Studies and General Abilities	Bilingual i.e., English and Telugu
Paper-II: Concerned Subject	English Only

LIST OF CONCERNED SUBJECTS	
1. Architectural Engineering	11. Geology
2. Automobile Engineering	12. Letter Press (Printing Technology)
3. Bio-Medical Engineering	13. Mechanical Engineering
4. Chemical Engineering	14. Metallurgy
5. Chemistry	15. Packaging Technology
6. Civil Engineering	16. Pharmacy
7. Electrical and Electronics Engineering	17. Physics
8. Electronics and Communication Engineering	18. Tannery (Leather Technology)
9. Electronics and Instrumentation Engineering	19. Textile Technology
10. Footwear Technology	

SYLLABUS

PAPER – I: GENERAL STUDIES AND GENERAL ABILITIES

1. Current affairs – Regional, National and International.
2. International Relations and Events.
3. General Science; India's Achievements in Science and Technology.
4. Environmental issues; Disaster Management- Prevention and Mitigation Strategies.
5. Economic and Social Development of India and Telangana.
6. Physical, Social and Economic Geography of India.
7. Physical, Social and Economic Geography and Demography of Telangana.
8. Socio-economic, Political and Cultural History of Modern India with special emphasis on Indian National Movement.
9. Socio-economic, Political and Cultural History of Telangana with special emphasis on Telangana Statehood Movement and formation of Telangana state.
10. Indian Constitution; Indian Political System; Governance and Public Policy.
11. Social Exclusion; Rights issues such as Gender, Caste, Tribe, Disability etc. and inclusive policies.
12. Society, Culture, Heritage, Arts and Literature of Telangana.
13. Policies of Telangana State.
14. Logical Reasoning; Analytical Ability and Data Interpretation.
15. Basic English. (10^{th} class Standard)

PAPER – II: CONCERNED SUBJECT

1. ARCHITECTURAL ENGINEERING (DEGREE LEVEL)

Basic Design: Design definition and description, Importance of Design, Fundamental elements of Design, Principles of design, Colour Theory, elements of composition, Anthropometrics Study, Ergonomics, Study of Different spaces, Optimum areas for various functions, Space standards, Lighting and Ventilation standards for various activities, Design Process and thinking and Introduction to the study of aesthetics.

Building Materials: Clay Bricks, Stones, Sand, Mortars, Cement, Concrete, Reinforced cement concrete, Timber, Veneers, Paints and Varnishes, Glass, Rubber, Adhesives, Asphalt & Bitumen, Plastics, Roofing & Flooring Materials, Metals, Ally Steels, Non-ferrous metals.

Building Construction: Foundations, Footings, Walls, Lintels, Carpentry & Joinery, Openings (doors & windows), Composite Masonry, Partition Walls, Staircases, Cladding, Sloping and flat roofs, Floorings, Structural steel work and Types of steel trusses

Architectural Drawing & Graphics: Importance of Scale, Different forms, Architectural representation of different objects, Solid geometry, Building Geometry – isometric, axonometric, etc., Types of Arches, Sciography, Perspectives, Rendering, visualization skills and importance of free hand drawing.

Engineering Mechanics: Simple stress and strain, Types of stresses, elastic limit, modulus of elasticity, Bending moment and shear forces, Moment of inertia, Deflection, Buckling & Crushing failures, Slenderness ratio, Torsion, Design of RCC & Steel Structures.

Introduction of art and architecture: Importance of art, Development and exploration of art, Relationship between art and architecture, Role of an architect in society, relationship with other consultants, Technical knowledge and expertise, Evolution of Shelter forms.

History of Architecture: Architectural development in Egypt, Greek, Roman, Early Christian, Romanesque, Gothic & Byzantine. Hindu & Islamic architecture. Influence of Industrial revolution on building materials, construction technology, characteristic styles of modern architecture, Arts and Crafts movement, Art Nouvean, Monumentalism, Expressionism and pioneers of Modern architecture and their contributions.

Surveying and Site Studies: Principles of Surveying, Traversing & Plain table surveying, Computation of Areas & leveling, Automated Surveying.

Water supply and Sanitary Engineering: Sources of water supply, Quality of water, Treatment of water, Distribution system of water, Collection and Treatment of refuse, Sewage, Principles of drainage, plumbing and Sanitary fittings and fixtures, Roads & Pavements.
Climatology: Building Climatology, Tropical Climates, Thermal Comfort, Heat flow, Natural ventilation, Passive cooling, Sun & Design Process.
Landscape design and site planning: Importance and role of landscape designing, Historical Perspective, Elements in Landscape design, Plants and design, Landscape construction.
Building Services: Electrical Services, Lighting, Air Conditioning, Elevators and Escalators, Telephones and EPABX, Security systems, Fire fighting systems, Swimming pools, Energy sources of building: wind energy, photo voltaic, Bio-mass, Waste Disposal: Industries & Hospitals, Hotel services and Elevated flooring, Green Building Concepts: Energy conservation, net zero energy consumption.
Sociology of Human settlements: Sociological aspects, Elements of society, Urbanization, Historic Evolution, Transportation and communication, Principles of ekistics.
Economics, Estimating and Costing: Introduction on economics, Micro and Macroeconomics, economic issues, Financing of a project, Quantity surveying and estimating (approximate and detailed) and rate analysis.
Town Planning: Town forms in urban planning and development processes, various levels of planning: national, regional, urban, rural, local etc., objectives of town planning, O-D surveys, F.S.I. planning of industrial and recreational areas, urban renewals, TCPO and Town planning organization in India and Geographical information systems (GIS).
Building Acoustics: Need to study acoustics, history of acoustics, generation, propagation, transmission of sound, characteristics of sound, sensibility of human ear, resonance, reverberation time, sabine's formula, echoes, principles of acoustical design process and sound isolation.
Advances Construction: Decay and Damage, Building Failures, Maintenance and Renovation, Guniting, Strutting, Underpinning, Grouting, Propping, Effect of ageing, Weathering.
Professional Practice: Types of offices for practice, COA registration and rules, IIA Code professional conduct, architects duties, principles of Indian contract act, Tenders, Contracts, Easements, Arbitration, Valuation, Role of Consultants, Building Bye-laws, National Building Code, Consumer protection act, transfer of property.
Computer Applications: Hardware and Software requirements, Operating systems, Features of presentation package, drafting packages, benefits of Internet technology, visualization software and building information modeling (BIM).

2. AUTOMOBILE ENGINEERING (DEGREE LEVEL)

01. Heat Transfer and Thermodynamics:

Heat Transfer: Conduction – Convection - Thermal Radiation - Heat Exchangers.

Thermodynamics: Concepts of Thermodynamics – Zeroth Law of thermodynamics – First law of thermodynamics – Second Law of thermodynamics – Entropy – Thermodynamic Processes and Air standard cycles.

02. Automobile Power Plants: I.C. Engines – Combustion in I.C. Engines and Combustion chambers – Fuel supply systems in S.I and C.I engines – Inlet and Exhaust systems – Automobile pollution and control systems – I.C Engine performance – Scavenging, super charging and Turbo charging of Engines – Lubricants and Lubrication systems – Engine Coolants and Cooling systems - Modern developments in I.C. Engines.

03. Strength of Materials: Simple stress and strain – Temperature stresses – Geometrical properties – Shear force and Bending moment – Theory of simple bending – Theory of Torsion – Deflection of beams.

04. Fluid Mechanics and Hydraulic Machinery: Fluid properties – Flow of Fluids - Flow past immersed bodies – Oil power Hydraulic systems – Hydraulic Machinery.

05. Automobile Instrumentation: Electronic components used in an automobile – Sensors & Transducers: Flow measurement - Temperature measurement – Speed measurement – Pressure measurement – Distance measurement.

06. Automobile Chassis and Body Engineering: Frames & Chassis layout – Types of automobile bodies – Body constructional materials – Body constructional details and Ergonomics - Body Production methods – Aerodynamics – Automobile air conditioning, Heating and Ventilating systems – Interior and Exterior Trimming – Noise and Acoustic insulation - Wind screens.

07. Automobile Transmission and Control systems: Automobile Transmission systems – Wheels, Tyres and tubes - Steering system - Wheel balancing and alignment – Braking system – Suspension system – Traction control systems – Safety systems.

08. Automobile Electrical Systems: Electricity and Magnetism – Electromagnetic Induction – Batteries – Self starter and Drive mechanisms – Generating Systems: D.C Generator - Voltage Regulator, Current regulator, Cut-out relay – Alternators, Electronic Voltage regulator – Ignition systems - Dash board Instruments and Gauges - Automobile illumination and Accessories – Automobile wiring systems: General Color coding of wires used, Wiring harness and earth return systems.

09. Material Science: Crystallography of metals – Binary alloys – Constitution and equilibrium diagrams – Methods of studying metal structure – Heat treatment - Non Ferrous metals and alloys – Destructive and Non destructive Tests.

10. Kinematics and Dynamics of Machines:

Kinematics – Velocity and Acceleration – Properties of instantaneous centre – Gears & Gears trains – Cams – Governors – Brakes and dynamometers – Clutches – Power transmission – Belt and Chain drives.

Dynamics of Machines: Static force Analysis – Dynamic Force Analysis – Dynamics of Reciprocating Engines – Balancing – Vibration Analysis of Single degree freedom systems – Torsional Vibrations – Vibration isolation.

11. Design of Automobile Parts: Design of Riveted and welded joints - Design of Bolts & Nuts – Shafts and Axles – Springs – Bearings – Clutches – Brakes – Design of engine components: Piston - Connecting rod – Crank shaft - Fly wheel.

12. Production Technology: Machine tools – Lathes – Shaper, planner and slotting machines – Drilling and boring machine – Milling – Grinding & Lapping– Welding – Brazing – Foundry – Modern machining Trends.

13. Industrial Engineering & Management: Industrial management – Personnel Management – Production Management – Production Planning and control – Wages and incentives – Cost Control – Quality management - Marketing and Sales Promotion.

14. Electric vehicles: Types and systems, Types of electrical motors used as drive motors and relative advantages and limitations – Charging methods – Electronic controller – Regenerative braking system – Hybrid vehicles: Types and systems.

15. Transport Management and Legal aspects of Motor Transport: Organisational structure – Operations – Planning of the fleet – Bus and Crew scheduling – Transport economics – Fare collection and Fare fixation methods – Legal aspects of Motor Transport.

16. Farm tractors: Classification of tractors – Main systems or assemblies of tractors – P.T.O systems in Tractors – Depth and draft control in tractor –Draw bar and its setting at exact height – Types of hitches – Hitching of implements.

17. Special Purpose Vehicles: Earth movers: Shovels – Backhoe – Dragline – Scrapers - Bull Dozers - Comparison between wheel dozer and Crawler dozer – Dozer blades - Mobile cranes – Dumpers.

18. Automobile Electronics: Electronic fuel systems – Electronic steering systems – Electronic Suspension systems – Computerized instrument systems – GPS system – CAN communication system – Engine Management: Electronic Control Unit (ECU) – Engine control module – Tyre pressure monitoring system – Immobilizer – Central locking systems.

19. Automobile Servicing and Maintenance: Automobile Service Station Equipment - Types of Maintenance – Machines and equipments used for Servicing and Re-conditioning – Servicing, Maintenance and Trouble diagnosis charts of various automobile systems.

3. BIO-MEDICAL ENGINEERING (DEGREE LEVEL)

Respiratory Measurements and Aid; Principles and techniques of impedance pneumography and pneumotachograph.

Ventilators : Parameters, system Concepts, Flow Gauges, Valves Humidifiers. Birds, Emerson, Bear Ventilators.

Audiometry: Common Tests and procedures, Air-conduction, Bone Conduction, Masking, Schematic Functional Diagram of an Audiometer.

Electro-Surgical Equipment: Electro - Surgical Units: Principles of Cutting, Coagulation, Spark Gap, Valve Transistorized Generators, Safety Features.

Laser: Basic Principles of Laser, Different types of Laser Equipment used in Surgery, Safety.

Fibre Optics: Principles and Applications: Endoscopes, Neonatal instrumentation, Incubators, Ophthalmic Instrumentation: Intra - ocular Pressure Measurement, Contacting and Non-contacting Types, Refractometers.

Anesthesia Equipment, Boyle's Apparatus, Gas Distribution Systems.

Ultrasound Applications for Surgery: Lithotripsy, Principles and Applications.

Introduction to Bio-Medical Instrumentation. General Characteristics of medical instrumentation like linearity, range, frequency response, signal-to-noise ratio and stability.

Amplifiers for Bio-Medical applications: Differential, Carrier amplifiers, Instrumentation amplifier, Isolation amplifier. Phase sensitive detector for LVDT. Principles of wave generation and shaping. Recorders and play devices for Bio-Medical applications. General features of ink-jet, thermosensitive and optical recorders. General features of display devices for bio-signals. Significance of non-fade display, Data acquisition and display using micro computers. ECG recording system. Block schematic diagram of ECG machine; amplifiers: circuits for ECG. Special types of ECG recorders. Noise problems and their elimination.

Electro-encephalography: Block schematic diagram of EEG recording system. General features of different blocks : specification of EEG amplifiers : qualitative requirements, 10-20 electrode system, Resting Rhythms and sleep stages.

Electro Myography: Block schematic diagram of EMG recording system. Measurement of nerve conduction velocity, EMG amplifiers. Design considerations of EMG amplifiers. Data display for EMG.

Blood Pressure and blood flows. Electronic techniques for indirect and direct measurement of blood pressure: measurement of blood flow by electromagnetic, doppler and plethysmographic methods.

Phonocardiography: Origin of heart sounds. Phonocardiographic instrumentation consisting of microphone, filters and signal conditioners.

Introduction to Radiography: Physical properties of; X-rays. Principles of generation of X-rays. Radiation energy distribution. Collimators and grids, Fluoroscopy. Image intensifiers. Digital X-ray system, Digital Mammographic X-ray Equipment.

Methods of Chemical analysis: Absorption photometry: Emission photometry; Fluorometry, Beer-Lamberts Law, Introduction to autoanalyzer. Chromatography for blood gas analysis, Colorimeters., Spectrophotometers, Electrophoresis, Principle of pH meter.

Electrical hazards during Bioelectric monitoring: safety, Codes, Standards. Micro and Macroshock and their physiological effects. Leakage currents and protection by use of isolation transformers. Equipotential grounding and earth free monitoring.

Electrical factors in Hospital Design : Electrical power supply systems in a hospital building, Proper installation and grounding for providing safety to the patient - electrical environment.

Ultrasonics: Basic principles of Medical Ultrasonics, Echo Techniques, Functional Block Diagram of Basic Pulse-Echo System for Diagnostic Purposes. Different Display Modes A-Mode, B-Mode, M-Mode, Types of Scan-B Scan, Principles of Echocardiography and Echoencephalography with Schematic Block Diagrams. Sector Scanners, and phased array scanners.

Introduction to Doppler Ultrasound, Blood flow through heart valves, peripheral vessels - Doppler flow meter. Display Devices for Ultrasonic Echo Imaging. Biological Effects of Ultrasound and Safety Precautions.

Magnetic Resonance Imaging: Basic Principles of Magnetic Resonance Imaging. Signal Excitation and Detection. Schematic Functional Diagram of MRI Scanner with its sub-systems. Magnet, Gradient system. R.F. Transmitter Receiver system, Computer and Image Display, Reconstruction Techniques, Medical Applications and safety precautions.

Computed Tomography: Basic Principles, System Components and Functions of Scanning System, Processing Unit, CT- Generations, CT-Detectors, Reconstruction Techniques - Viewing systems, storage and documentation. Medical applications and safety precautions.

Radio Nuclide Imaging: Principle, Radio-Isotopes in medical diagnosis, Radiation detectors, Pulse height Analyzers, Schematic functional diagram and Components of Gamma Camera. Medical Applications, safety and precautions.

Medical Thermography: Basic Principle, Functional Block Diagram of thermo graphic equipment, scanning and display arrangements for Infra-Red Imaging, Medical applications.

Position emission tomography: Basic Principles, Nuclear Reactions and production of precursors. Detector Materials reconstruction techniques. Principle of SPECT and applications.

Defibrillators: D.C. Defibrillators of capacitive discharge and delay line capacitive discharge with basic circuit diagrams. Types of electrodes and their features. Implantable Defibrillators, Testing and safety.

Cardioverters: Working Principles, Scheme of synchronizing D.C. Defibrillators with the R-wave of ECG. Testing and safety. Cardiac pacemakers: Types -

i. Asynchronous and Synchronous (demand) mode of operation.
ii. External and implantable, Asynchronous Pacemakers.

Working principles, block diagram and circuit diagram of blocking oscillator asynchronous pacemaker.

Synchronous / Demand Pacemaker: Working principles, modes of triggering-ventricular triggered (QRS triggered) and atrioventricular synchronized pacemaker (P wave triggered).

Implantable pacemaker: Technical and qualitative requirements of power supplies, lead wires and electrodes. Transcutaneous R.F. powered Cardiac pacemaker system. Susceptibility of implanted pacemaker to electrical interference and remedial measure. Assist Devices for the Heart: Principles of external counter-pulsation techniques. Infra-aortic Balloon pump. Auxiliary ventricle and schematic for temporary by-pass of left ventricle.

Biomaterials: Significance of Biocompatibility, Types of biomaterials, in-vitro,in-vivo testing of biomaterials, Factors influencing implants, Orthopedic Implants, Ophthalmic & Dental applications of Biomaterials.

Prosthetic Heart Valves: Qualitative requirements. Categories Mechanical and tissue valves. Types of mechanical Valves - ball and cage, tilting disc and bi-leaflet valves. Types of tissue valves - Homograft or allograft (human cadaver) and Heterografts or Xenografts (Porcine or Bovine). In vitro performance testing of prosthetic heart valves using a pulse duplicator.

Heart- Lung Machine: Governing principles, qualitative requirements, functional details of bubble, thin film and membrane - Type of blood oxygenators.

Hemodialyzer: Qualitative requirements. General Scheme of operation. Types of Exchangers, block diagram, electronic control and monitoring systems.

Intensive Coronary Care Concepts: Systems organization, Critical Physiological parameters to be monitored. Bedside patient monitors, central station, Apnoea monitor, Layout and safety precautions.

Physical Therapy Equipment. Short wave, Microwave and Ultrasonic diathermy. Electrical stimulators.

Nernst equation - derivation and its significance. Refractory period. Characteristics of stimulus. Strength-duration relationship. Electrical equivalent circuit of an axon. Membrane time and space constants. Hodgkin Huxley formulation. Membrane conductance. Nerve conduction membrane properties from current voltage relations, models of squid axon. Propagation of impulses in unmyelinated and myelinated nerve fibre. Electrical properties of receptors. Generator potential of Receptors. Intensity-frequency relationship. Electrical properties of synaptic junctions - EPSP and IPSP.

Electrical Activity of the heart. Conduction system of the heart. Characteristics of Action potentials at SA mode, via, AV Node, purkinje firbres and ventricles, ECG complexes. The international standard 12 leads of ECG. Standard leads of Einthoven, precordial leads and augmented limb leads. Relationship between unipolar leads and standard bipolar leads. Volume conductor fields: Bio-electric sources, Volume-conductor formulation. Solid angle computation. Infinite cylindrical axon, core conductor model non-homogenous media, integral equations.

Electrical activity of skeletal muscles-motor unit potentials. EMG wave form. Surface and needle electrodes for EMG. Velocity and their changes in normal and abnormal states. Fatigue and conduction - chemical significance.

Introduction to bioelectric Phenomena of hearing - Mechanical equivalent schematic diagram of the ear. Mechanical transformer of the middle ear. Frequency analysis of sound by the basilar membrane. Cochlear microphonics.

Interaction between Engineering and life sciences. Definition of Biomedical Engineering, its scope. The role of Biomedical Engineer in Health care delivery systems. Medical Electronics Industry Research, Development and education.

Application of Engineering concepts and methods for understanding Physiological systems. Basic electrical and Mechanical properties skeletal systems, muscular system, heart and brain. Nervous system as an internal communication system of the human body, Sense Organs.

Electrophysiology: Functional structure of a cell. Basis of biopotentials. Resting potential of a nerve cell and its ionic mechanisms. Properties of excitable membranes. Action potential generation, its ionic mechanism and its characteristics.

Physiological signals, Characteristics, Basis of ECG, EMG, EEG and qualitative treatment of instrumentation for measuring these signals.

Biopotential, Electrodes, Electrode - Electrolyte Interface. Internal electrodes like needle electrodes and microelectrodes.

Equivalent circuit Properties.

Transducers for physiological application. Static-types like variable R.L. & C, LVDT, Therma couples, Thermistors Photo electric and Dynamic types like piezoelectric and moving coil type and their applications. Special requirements.

Development of instrumentation for Clinical practice and Medical Research, Introduction. Comparative study of industrial and Medical Instrumentation. Basic classification of Medical Instruments, Instrument characteristics, linearity, range, frequency response, signal to noise ratio and stability.

Broad classification of Biomedical Instrumentation for Clinical practice that is:

1. Instrumentation for Diagnosis, ECG, EEG, EMG, PCG etc.,
2. Therapeutic Devices - Stimulators, diathermy equipments etc.,
3. Prosthetic Devices - Pacemakers, Artificial Organs.
4. Visualizing Devices - X-ray, Ultrasound etc., fibre optic endoscope.
5. Electrosurgical Devices - HF Surgery, Laser Surgery.
6. Data Storage & Analysis - Computers in medicine.
7. Analytical Instruments - Photocolorimetry, Spectrophoto Meter, Electrophoresis, Centrifuges, Waterbath etc., Hospital illumination, Theatre illumination, Requirements and typical arrangements. Miscellaneous equipment’s.

4. CHEMICAL ENGINEERING (DEGREE LEVEL)

1. Fluid Mechanics : Dimensional analysis, fluid statics, fluid flow phenomena, basic equations of fluid flow, flow of incompressible fluids in pipes – Newtonian and non-Newtonian fluids, viscosity, Bernoulli's theorem, friction losses, friction factor, Hagen–Poiseuille equation. Turbulent flow, Transportation and metering of fluids. Different types of pumps for transportation of fluids -Calculation of pump power for transportation of fluids, flow meters – orifice, Venturi and Rotameters. Flow past immersed bodies, fluidization - packed bed and fluidized bed.
2. Heat Transfer: Conduction in solids – Steady state and unsteady state. Heat flow in fluids – overall heat transfer coefficient, Log-mean temperature difference, calculation of individual heat transfer coefficient and overall heat transfer coefficient. Fouling factors, Heat transfer to fluids without phase change – Thermal boundary layer, heat transfer by forced convention in laminar flow and in turbulent flow, empirical equations; Heat transfer from condensing vapors. Types of heat exchange equipment, counter current and parallel current flows. Evaporation – liquid characteristics and important properties, types of evaporators, condensers, ejectors- evaporator economy- single and multiple effects –related problems. Radiation – fundamentals, emission of radiation, black body radiation, laws of black body radiation – radiation between surfaces.
3. Mass Transfer: Molecular diffusion in fluids, inter phase mass transfer, mass transfer coefficients, Distillation (binary system), gas absorption and adsorption, liquid-liquid extraction, leaching, humidification, drying and crystallization operations. Equipment for distillation, gas absorption, liquid-liquid extraction, drying, humidification and crystallization.
4. Reaction Engineering: Rate of reaction, variables affecting the rate of reaction. Interpretation of kinetic data in batch and flow systems. Theories of reaction rate, classification of reactors, design equations for batch and flow reactors, Catalysis.
5. Thermodynamics: First law of thermodynamics – Internal energy, Enthalpy, heat capacity, PVT relationships for gases, first law for open systems. Second law of thermodynamics – statement, entropy function, calculations of entropy changes. Free energy functions. Calculation of enthalpy and entropy as function of pressure and temperature, Heat effects. Criteria for equilibrium and their application.
6. Mechanical Operations: Size reduction, Properties, Handling and Mixing of particulate solids, laws of size reduction- crushers and grinders. Different types of equipments for mixing dry powders, differential and cumulative screen analysis, screen effectiveness, average particle size .Mechanical separations, Screening, Filtration, Sedimentation, froth floatation. Conveying and Storage of solids.
7. Process Technology : Manufacture of following chemical products in process industries – Location and uses – Water, Inorganic chemical industries (sulfuric acid, phosphoric acid, Soda ash, Caustic soda and Chlorine industry), fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals (Coal chemicals, coking of coal, coal tar distillation, petroleum refining-atmospheric distillation and vacuum distillation , fluid catalytic cracking , catalytic reforming , petrochemicals from methane and ethylene); polymerization industries (polyethylene, polypropylene, PVC and polyester synthetic fibres). Cement, Electro thermal industries; Calcium carbide, Silicon carbide, Graphite, Pigments and Paints.
8. Material and Energy Balances : Basic calculations, Determination of molarity, molality & normality, analysis of solids , liquids and gases on dry and wet basis , Daltons law , ideal gas equation of state , vapor pressure boiling point and freezing point , elevation of boiling point and depression of freezing point-uses, Bypassing ,Recycling & purge streams – uses , limiting component , excess reactant , percentage conversion & yield and degree of completion , Material balances with and without chemical reactions, law of conservation of energy , heat of reaction , heat of formation , and heat of combustion – related problems , gross and net calorific values , theoretical air and excess air calculations
9. Instrumentation and Process Control: Qualities of measurement, measurement of temperature, pressure and vacuum, liquid level, density and viscosity, composition and analysis. Process control _ Automatic process control – Elements of a control system-Static and dynamic characteristics of an instrument – Controllers modes of control and its applications.
10. Material technology: Mechanical properties of metals and Testing of materials – thermal equilibrium diagram- Production of Iron-plain carbon steels, alloy steels - Miscellaneous materials – Glass, carbon, graphite, rubber, elastomers, fiberglass and FRP etc. – Corrosion causes, types, methods of prevention .
11. Environmental Studies and Pollution Control Engineering: Scope and importance of environmental studies, segments, Eco systems, bio diversity, water pollution, types, classification, treatment methods, air pollution, types, classification, analysis, control

methods, solid waste management, sources, classification, disposal, pollution control in sugar, fertilizer & petroleum industries, legal aspects.

12. Energy Technology & Plant Operation: Classification of energy sources-Solid, Liquid, and Gaseous fuels – Combustion principles, Refractories, Furnaces - Blast Furnace, LD Converter - Nuclear Energy, Solar Energy, Wind Energy and Bio-Energy – Energy Conservation - Industrial Hazards and Prevention -Safety and first AID.

5. CHEMISTRY (POST GRADUATE LEVEL)

INORGANIC CHEMISTRY:

1. Atomic structure and chemical bonding – structure and bonding in homo and hetero nuclear molecules. Application of VSEPR, Valence Bond and Molecular orbital theories in explaining the structures of simple molecules.
2. Chemistry of main group (I to VII & Nobel gases) elements.
3. Chemistry of transition elements and inner transition elements.
4. General principles of metallurgy: Occurrence of metals, Concentration of ores - levigation, magnetic separation, froth floatation, leaching, Extraction of crude metal from concentrated ore-conversion to oxide, reduction of oxide to the metal, Thermodynamic principles of metallurgy-Ellingham diagram limitations, applications. Extraction of iron, copper and zinc from their oxides, Electrochemical principles of metallurgy, Oxidation and reduction, Refining of crude metal-distillation, liquation poling, electrolysis, zone refining and vapour phase refining, Uses of aluminium, copper, zinc and iron. Alloys: Inter-metallic compounds
5. Coordination Chemistry –IUPAC nomenclature, bonding theories – Werner's theory, EAN rule, VBT, Crystal Field Theory – Crystal Field splitting patterns in various geometries, Factors affecting on CFT. Calculation of CFSE – John Teller effect – Isomerism in complexes. Spectral and magnetic properties of Coordination complexes – Russell Sanders coupling – term symbols - charge transfer spectra of complexes.
6. Stability of metal complexes – Stepwise and overall stability constants – Factors affecting the stability of metal complexes - Chelate effect. Pearson's theory of hard and soft acids and bases (HSAB).
7. Reaction mechanism of metal complexes–Inert and labile complexes – Ligand substitution reaction of octahedral complexes – Acid hydrolysis, Base hydrolysis – Conjugate base mechanism – Anation reactions – Substitution reactions of square planar complexes – Trans effect – Electron transfer reactions – Inner and outer sphere mechanisms.
8. Metal carbonyls, Nitrosyls and Metallocenes - Structure and bonding.
9. Bio-inorganic chemistry- Metal complexes as oxygen carriers-Hemoglobin and myoglobin-Oxygen transport – Non heme proteins – Hemerythrin and hemocyanin.
10. Analytical chemistry- Chromatography – General principles involved in separations by Paper, Thin layer, Column Chromatography, GC and HPLC.

PHYSICAL CHEMISTRY:

1. Solutions and colligative properties: Types of solutions, Expressing concentration of solutions mass percentage, volume percentage, mass by volume percentage, parts per million, mole fraction, molarity and molality, Solubility: Solubility of a solid in a liquid, solubility of a gas in a liquid, Henry's law, Vapour pressure of liquid solutions: vapour pressure of liquid- liquid solutions. Raoult's law as a special case of Henry's law -vapour pressure of solutions of solids in liquids, Ideal and non-ideal solutions, Colligative properties and determination of molar mass - Relative lowering of vapour pressure, elevation of boiling point, Depression of freezing point, Osmosis and osmotic pressure-reverse osmosis and water purification. Abnormal molar masses - van't Hoff factor. Phase equilibria– Phase rule and its application to one component and two component systems
2. Acids and bases: Acids, bases and salts- Arrhenius, Bronsted-Lowry and Lewis concepts of acids and bases. Ionisation of Acids and Bases –Ionisation constant of water and it's ionic product- pH scaleionisation constant of weak acids and weak bases-relation between Ka and Kb. Di and poly basic acids and di and poly acidic Bases-Factors affecting acid strength-Common ion effect in the ionization of acids and bases-Hydrolysis of salts and pH of their solutions. Buffer solutions.
3. Thermodynamics: Brief review of concepts of I and II laws of thermodynamics. Concept of entropy. Entropy as a state function. Calculation of entropy changes in various processes. Entropy changes in an ideal gas. Entropy changes on mixing of ideal gases. Entropy as a function of V and T. Entropy as a function of P and T. Entropy change in isolated systems- Clausius inequality. Entropy change as criterion for spontaneity and equilibrium. Third law of thermodynamics. Evaluation of absolute entropies from heat capacity data for solids, liquids and gases. Standard entropies and entropy changes of

chemical reactions. Helmholtz and Gibbs free energies (A and G). A and G as criteria for equilibrium and spontaneity. Physical significance of A and G. Driving force for chemical reactions- relative signs of ?H and ?S. Thermodynamic relations. Gibbs equations. Maxwell relations. Temperature dependence of G. Gibbs- Helmholtz equation. Pressure dependence of G. Chemical potential: Gibbs equations for non-equilibrium systems. Material equilibrium. Phase equilibrium. Clapeyron equation and Clausius-Clapeyron equation. Conditions for equilibrium in a closed system. Chemical potential of ideal gases. Ideal-gas reaction equlibrium-derivation of equilibrium constant. Temperature dependence of equilibrium constant - The Van't hoff equation.

4. Electrochemistry: Conductance and its applications, Derivation of Nernst equation. Chemical and concentration cells (with and without transference). Liquid junction potential – derivation of the expression for L J P – its determination and elimination. Applications of EMF measurements: Solubility product, potentiometric titrations, determination of transport numbers, equilibrium constant measurements. Decomposition potential and its significance. Electrode polarization – its causes and elimination. Concentration over potential. Concept of activity and activity coefficients in electrolytic solutions. The mean ionic activity coefficient. Debye-Huckel theory of electrolytic solutions. Debye-Huckel limiting law. Calculation of mean ionic activity coefficient. Limitations of Debye-Huckel theory. Extended Debye-Huckel law. Theory of electrolytic conductance. Derivation of Debye-Huckel-Onsager equation – its validity and limitations. Concept of ion association – Bjerrum theory of ion association (elementary treatment) - ion association constant – Debye-Huckel-Bjerrum equation.
5. Quantum chemistry: Black body radiation-Planck's concept of quantization-Planck's equation, average energy of an oscillator. Wave particle duality and uncertainty principle - significance for microscopic entities. Emergence of quantum mechanics. Wave mechanics and Schrödinger wave equation. Operators - operator algebra: Commutation of operators, linear operators, Complex functions, Hermitian operators. Operators and. Eigen functions and Eigen values. Degeneracy. Linear combination of Eigen functions of an operator. Well behaved functions. Normalized and orthogonal functions. Postulates of quantum mechanics. Physical interpretation of wave function. Observables and operators. Measurability of operators. Average values of observables. The time dependent Schrodinger equation. Separation of variables and the time-independent Schrodinger equation.
6. Chemical kinetics: Theories of reaction rates - Collision theory, Transition state theory, Reaction coordinate, activated complex and the transition state. Thermodynamic formulation of transition state theory. Unimolecular reactions and Lindeman's theory.
7. Photochemistry: Electronic transitions in molecules - The Franck Condon principle. Electronically excited molecules- singlet and triplet states. Radiative life times of excited states-theoretical treatment. Measured lifetimes. Quantum yield and its determination. Actinometry - ferrioxalate and uranyl oxalate actinometers. Derivation of fluorescence and phosphorescence quantum yields. E-type delayed fluorescence- evaluation of triplet energy splitting (?EST). Laws of photo chemistry, Photo physical processes, photo physical kinetics of unimolecular reactions. Calculation of rate constants of various photo physical processes, State diagrams, photochemical primary processes. Types of photochemical reactions- electron transfer, photo dissociation, addition, abstraction, oxidation and isomerisation reactions with examples. Effect of light intensity on the rates of photochemical reactions. Photosensitization. Quenching-Stern Volmer equation. Experimental set up of a photochemical reaction. Introduction to fast reactions- Principles of flash photolysis.
8. Solid state chemistry: General characteristics of solid state. Classification of crystalline solids based on different binding forces, probing the structure of solids: X-ray crystallography, Crystal lattices and unit cells. Bravais lattices- primitive and centred unit cells, Number of atoms in a unit cell (primitive, body centred and face centred cubic unit cell), Close packed structures: Close packing in one dimension, in two dimensions and in three dimensions- tetrahedral and octahedral voids- formula of a compound and number of voids filled- locating tetrahedral and octahedral voids, Packing efficiency in simple cubic, bcc and in hcp, ccp lattice. Calculations involving unit cell dimensions density of the unit cell. Imperfections in solids-types of point defects-stoichiometric and non-stoichiometric defects. Magnetic properties of solids- classification of magnetic materials, Magnetic susceptibility, Langevin diamagnetism, Weiss theory of para magnetism. Magnetic properties of solids - classification of magnetic materials, Magnetic susceptibility, Langevin diamagnetism, Weiss theory of para magnetism Electronic properties of metals, insulators and semi conductors: Electronic structure of solids, Band theory, band structure of metals, insulators and semiconductors. Electrons holes and excitons. The temperature dependence of conductivity of extrinsic semi conductors. Photo conductivity and photovoltaic effect.

ORGANIC CHEMISTRY:

1. IUPAC nomenclature of organic molecules. Isomerism – classification of isomers.
2. Classification, preparations and properties of alkane, alkenes, alkynes, cyclo alkanes, aromatic hydrocarbons, halogen compounds, hydroxy compounds, carbonyl compounds, carboxylic acids and its derivatives.
3. Stereo chemistry: Molecular representations (Wedge, Fisher, Newman and Saw-horse projection formula) their description and interconversions. Stereoisomers – lassification- configuration- R,S- Nomenclature, criteria for chirality, Axial chirality of allenes, spiranes, alkylidenes, Cycloalkanes, chiral biaryls - Atropisomerism. Planar chirality of ansa compounds and trans- cyclooctene. Helical chiral compounds. Determination of absolute configuration by chemical correlation methods. Determination of configuration in E,Z- nomenclature. Spectral and chemical methods for determination of E, Zconfiguration, including aldoxime and ketoximes.
4. Introduction to conformational isomerism, Klyne - Prelog terminology for conformers and torsion angles, dihedral angle, Steric strain and the concept of dynamic stereoisomerism. Study of conformations of acyclic compounds like ethane, butane, dihalobutanes, halohydrin, ethylene glycol, butane-2, 3-diol, amino alcohols and 1,1,2,2-tetrahalobutanes.
5. Nature of bonding in organic molecules and aromaticity, delocalized chemical bonding, conjugation, cross conjugation, resonance, hyperconjugation, tautomerism, Huckel's Rule and the concept of aromaticity-Aromaticity, non-aromaticity and anti aromaticity.
6. Reactive intermediate: Generation, detection, structure, stability and reactivity of carbocation, carbanion, free radical, carbene and nitrene. Molecular rearrangements: definition and classification, molecular rearrangements involving 1). Electron deficient carbon: Wagner - Meerwein, Pinacol-Pinacolone, allylic and Wolf rearrangement. 2). Electron deficient Nitrogen: Hofmann, Lossen, Curtius, Schmidt and Beckmann rearrangements. 3) Electron deficient Oxygen: Baeyer-Villiger oxidation. 4). Base catalysed rearrangements: Benzylic acid, Favourski, Tran annular, Sommlett-Hauser and Smile rearrangement.
7. Organic reaction mechanism: Mechanism, stereochemistry and energy profile diagram of Addition reactions to polar and non polar double bonds. Substitution reactions: Mechanism, rate law, stereochemistry and factors affecting on aliphatic and aromatic reactions. Elimination reactions- mechanism, rate law, stereochemistry, orientation and factors affecting on E1, E2, E1CB, pyrolytic syn elimination and a-elimination, elimination vs substitution. Detection of reaction mechanism by product isolation, isotopic labelling, chemical trapping and crossover experiments.
8. Oxidation- Swern, Cr (VI) oxidants, Oxidative cleavage of 1,2-diols - Periodic acid and Lead tetra acetate.
9. Reductions - Wilkinsons's catalytic hydrogenation, $LiAlH_4$, $NaBH_4$, BH_3, AlH_3 and DIBAL.
10. Heterocyclic chemistry: importance as drugs, nomenclature, classification based on size of the ring, number and nature of hetero atoms. Synthesis and reactivity of Pyrrole, furan, Thiophene, pyridine, Indole, Benzothiophene, Quinoline, Isoqunolines.
11. Alkaloids and Terpenoids- importance as drugs, isolation of natural products by steam distillation, solvent extraction and chemical methods. Structure determination and synthesis of papverine, nicotine and quinine. General methods in the structure determination of Terpenes, isoprene rule, special isoprene rule, structure determination of a-Terpeniol and camphor.
12. Organic photochemistry: photochemical energy, Frank-Condon principle, Jablonski diagram, Electronic transitions, photosensitization, quenching, quantum efficiency, quantum yield, photochemistry of carbonyl compounds n?p* and p?p* transitions. Norrish type-I and Norrish type-II cleavages. Paterno-Buchi reactions, Photoreduction, photochemistry of enones- hydrogen abstraction, rearrangements of a,ß-unsaturated ketones and cyclohexadienones, photochemistry of pbenzoquinones, Dienes - photochemistry of 1,3- butadiene, (2+2) additions, Di-p-methane rearrangement, photochemistry of aromatic compounds, excited states of benzene and its 1,2-, 1,4- additions.
13. Pericyclic reactions: Classification, Stereochemistry of pericyclic reactions, Molecular Orbitals and Symmetry of ethelene, 1,3-butadiene, 1,3,5-hexatriene, allylic, 1,3-pentadienyl and 1,3,5-heptatrienyl p- systems. Analysis of pericyclic reactions by PMO, FMO and orbital correlation methods.

14. Basic principles, concepts of UV, IR, H1NMR, C13NMR and Mass spectroscopic methods – structure determination of organic compounds by UV, IR, H1NMR, C13NMR and Mass spectroscopic methods.
15. Green chemistry: Principles of Green chemistry, and its approaches.

6. CIVIL ENGINEERING (DEGREE LEVEL)

1. Building Materials And Construction:

Bricks– Types of Bricks, Indian standard classification, properties; Stones – Types of stones, classification, properties, dressing and polishing of stones; Methods of Quarrying; Cement – Different grades and types of cement, properties and IS specifications; Aggregates – coarse and fine aggregate, properties and IS specifications; Cement Mortar – Proportions of cement mortar for various applications; Concrete – Constituents of Concrete, Different grades of Concrete, mix proportioning using IS Code, Properties of fresh and hardened Concrete; Admixtures – Types of Admixtures.

2. Strength of Materials And Theory of Structures:

Strength of Materials: Simple stresses and strains, elastic constants and relationship between them; Compound bars; Temperature stresses; Shear forces and bending moment diagrams for beams; Principal stresses and Mohr's circle of stress, Theory of bending and bending stresses; Shear stress distribution; Theory of torsion; Springs; Deflections of beams; Thin and thick cylinders;; Analysis of trusses, Betti-Maxwell theorem; Shear centre and unsymmetrical bending.

Theory of Structures: Direct and bending stresses; Columns and struts; Strain energy method; Moving loads and influence lines; Arches and suspension bridges; Static and kinematic indeterminacy; Moment distribution, Slope deflection, and Kani's methods applied to continuous beams and portal frames; matrix methods of analysis.

3. Cement Concrete and Steel Structures:

Concrete Structures: Materials, permissible stresses and IS Specifications; Working stress methods; Limit State Method - Stress Blocks parameters, design of Beams, Slabs, Columns and Footing; Design for Shear and Torsion; Design of Retaining Walls, Water tanks, and T-Beam Slab bridges; Yield line theory.

Steel Structures: Properties of steel sections, permissible stresses, IS Specifications; Riveted and welded joints and connections; Design of simple and compound Beams and Columns, Column bases, Roof trusses, Plate and Gantry Girders; Plate Girder Lattice Girder Railway bridges, and Bearings. Plastic analysis.

Pre-Stressed Concrete: Basic concepts, material for pre-stressing, losses in Pre-stress, classification of pre-stressing system; Analysis of PSC Sections.

4. Fluid Mechanics and Hydraulics:

Fluid Properties; Measurement of Pressure - Manometers; Fluid Kinematics – Classification of Fluids, Stream function and Velocity potential, significance and use of Flownets, Fluid dynamics - Continuity equation, Bernoulli's equations and Impulse momentum equation; Laminar and Turbulent flow through pipes – significance of Reynolds number, Hagen – Poiseuille's equation, Darcy – Weisbach equation, Friction factor, Water hammer concepts; Compressible flow – Bernoulli's equation for Isothermal and Adiabatic conditions, Mach Number, Mach cone, stagnation properties; Steady uniform flow through open channels; Gradually varied flows – significance of Froude number, classification and computation of Flow profiles, Hydraulic jump, Surges; Boundary layer – Laminar and Turbulent Boundary layer, Boundary layer thickness, rough and smooth Boundaries, Boundary layer separation; Dimensional analysis and similarity laws; Hydraulic Turbines – classification, Velocity triangles, principles and design of reaction and impulse turbines; Centrifugal pumps – specific speed, work done and efficiency, characteristic curves.

5. Hydrology and Water Resources Engineering:

Hydrological cycle; Rainfall – types and measurement, network design; Infiltration -ϕ-index; Runoff – process, factors and determination of runoff, dependable yield; Floods – flood hydrograph, computation of flood peak using rational formula, unit hydrograph method and Gumbel's extreme value methods; Groundwater – types of aquifer and properties, Darcy's law, specific yield, steady radial flow to wells in confined and unconfined aquifers; Irrigation – types and advantages, soil water plant relationship, consumptive use, duty, delta, base period, crops and their water requirements; Single and multipurpose projects; Dams – classification, forces and design of Gravity dam and Earth dam; Spillways – types, energy dissipation, stilling basin, Appurtenances; Canals – alignment, Kennedy's and Lacey's theories, lining of Canals; Weirs – components, design of vertical drop and sloping glacis weir; Seepage forces – Bligh's Theory,

Khosla's theory; Canal falls – types and design principles; Cross drainage works – classification and design principles of aqueducts; Hydropower principles – classification and components of Hydroelectric power plants.

6. **Environmental Engineering:**

Water supply – objectives, rate of demand, population forecasts; Analysis of water – classification, design of coagulation, sedimentation, filtration, disinfection and softening processes; Methods of layout of distribution pipes – Hardy cross method; Waste water engineering – systems of sewerage, hydraulic formulae and design of sewers, BOD, COD, self purification of natural streams, methods of sewage disposal; Treatment of sewage – principles and design of grit chamber, sedimentation tanks, trickling filters, activated sludge process, sludge digestion tanks, septic tanks; Municipal solid waste – characteristics, collection and transportation of solid wastes; Air Pollution – types and sources of pollutants, air quality standards; Noise pollution – Impacts and permissible limits, measurement and control of noise pollution.

7. **Transportation Engineering:**

Highway Classification as per IRC; Highway alignment; Engineering Surveys; Geometric Design; Cross sectional elements of road; Gradient; Grade compensation; Traffic Surveys – speed, Volumes, origin and destination; Intersection – at grade and grade separated; Channelization; Rotary intersection; signal design – webstar method, traffic signs, pavement marking; Parking studies, accidental studies, pavement types, Factors considered for pavement design, flexible and rigid pavements design concepts.

Railway Engineering: Permanent way, rails, sleepers, ballast; Creep, coning of wheel, rail fixtures and fastenings, super elevation, cant deficiency, curves, turnout; Points and crossings.

Airport Engineering: Selection of site of Airport, runway orientation and design, wind rose diagram, basic run way length, correction to basic runway length.

8. **Soil Mechanics and Foundation Engineering:**

Soil Mechanics: Physical properties of soils, Classification and identification, Permeability, Capillarity, Seepage, Compaction, Consolidation, Shear Strength, Mohr's circle, Earth pressure, Slope stability;

Foundation Engineering: Site investigations, stress distribution in soils, Bearing capacity, Settlement analysis, Types of Foundation, Pile foundations, Foundations on expansive soils; swelling and its preventions; Coffer dams, Caissons, Dewatering, Bracing for excavations, Newmark charts, machine foundations.

Engineering Geology: Mineralogy, Structural Geology, Groundwater Exploration methods; Engineering Geology applications for Tunnels, Dams and Reservoirs; Geological hazards and preventive measures.

9. **Estimation, Costing and Construction Management:**

Abstract estimate: Detailed estimate – centerline, long & short wall method, various items of Civil Engineering works as per Indian Standard, General Specifications - Earth Work, Brick / Stone Masonry in Cement Mortar, RCC, Plastering in Cement Mortar, Floor finishes, white wash, colour wash; Standard schedule of rates, lead and lift, preparation of lead statement; Computation of earth work – Mid-ordinate, Mean Sectional area, Trepezoidal method, Prismoidal Rule; Approximate estimate – Plinth area and cubic rate estimate.

10. **Construction Management:**

Types of construction projects, Tendering and construction contracts, project planning and network analysis – PERT and CPM.

11. **Surveying:**

Principle and classification of surveying, chain surveying; Compass surveying; Levelling and contouring; Theodolite surveying; curves; Introduction and Fundamental concepts of electronic measuring instruments – EDM, Total station, components of GPS and basics of GIS.

7. ELECTRICAL AND ELECTRONICS ENGINEERING (DEGREE LEVEL)

1. Electric Circuits and Fields: Network graph, KCL, KVL, node and mesh analysis, transient response of dc and ac networks; sinusoidal steady-state analysis, resonance, basic filter concepts; ideal current and voltage sources, Thevenin's, Norton's, Superposition, Maximum Power Transfer and Reciprocity theorems; two-port networks, three phase circuits; Star, Delta connections, Measurement of power in 3-phase by two-wattmeter method; Fourier, Laplace and Z transforms; Gauss Theorem, electric field and potential due

to point, line, plane and spherical charge distributions; Ampere's and Biot-Savart's laws; inductance; dielectrics; capacitance.

2. Electrical Machines: Single phase transformer - equivalent circuit, phasor diagram, tests, regulation and efficiency; three phase transformers - connections, parallel operation; auto-transformer; energy conversion principles; DC machines - types, windings, generator and motor characteristics, losses and efficiency, armature reaction and commutation, starting and speed control of motors, tests; three phase induction motors - principles, types, performance characteristics, starting and speed control; single phase induction motors; synchronous machines - performance, regulation and parallel operation of alternators, motor starting, characteristics and applications; servo motors.

3. Power Systems: Basic power generation concepts, Economic aspects, Types of Tariffs; transmission line models and performance; cable performance, insulators, Sag and Tension; corona and radio interference; distribution systems; per-unit quantities; bus impedance and admittance matrices; load flow study; voltage control; power factor correction; economic operation; Load Frequency Control; symmetrical components; symmetrical & unsymmetrical fault analysis; principles of over-current, differential and distance protection; Generator protection, Transformer protection, Feeder protection, static relays; circuit breakers; Power system stability concepts, swing equation, power angle curve, solution of swing equation, equal area criterion.

4. Control Systems: Principles of feedback; transfer function; block diagrams; steady-state errors; Routh and Nyquist techniques; Bode plots; root loci; lag, lead and lead-lag compensation; state space model; state transition matrix, controllability and observability.

5. Electrical and Electronic Measurements: DC, AC Bridges, potentiometers; PMMC, moving iron, dynamometer and induction type instruments; measurement of voltage, current, power, energy and power factor; shunts, multipliers; instrument transformers; digital voltmeters, CRO; phase, time and frequency measurements using lissajous patterns; error analysis.

6. Analog and Digital Electronics: Characteristics of p-n junction diode, Zener diode, BJT, FET; amplifiers - biasing, equivalent circuit and frequency response; oscillators and feedback amplifiers; operational amplifiers - characteristics and applications; simple active filters; VCOs and timers; Boolean Algebra, mizimizition of switching functions combinational and sequential logic circuits; schimitt trigger, multi vibrators Flip flops, counters and registers, sample and hold circuits; A/D and D/A converters; microprocessor basics.(8085 & 8086), architecture, programming and interfacing, 8051 mc BASICS (Architectures. Addressing modes and instruction set).

7. Power Electronics : Semiconductor power diodes, transistors, thyristors, triacs, GTOs, MOSFETs and IGBTs - static characteristics and principles of operation; triggering circuits commutation circuits; phase control rectifiers; bridge converters - fully controlled and half controlled; dual converters, principles of choppers, inverters, cyclo-converters and ac voltage controllers.

8. Electric Drives: Four quadrant operation, Types of loads, Energy loss during starting and braking of dc and ac motors, Types of braking in dc & ac motors, Basis concepts of converter and chopper fed dc drives; V/f control, static rotor resistance control and slip power recovery scheme of 3-phase induction motor drives.

9. Utilization: High frequency eddy current heating, dielectric heating, Arc furnace, electric arc welding & electric resistance welding, Illumination: Laws of illumination, MSCP, SV & MV lamps, Factory, street & flood lighting, Electric traction and track electrification, Speed-time curves, Tractive effort, Specific energy consumption, Mechanism of train movement, adhesive weight and coefficient of adhesion. DC motor series parallel control, energy saving.

8. ELECTRONICS & COMMUNICATION ENGINEERING (DEGREE LEVEL)

Section-I

Engineering Mathematics

Linear Algebra: Vector space, basis, linear dependence and independence, matrix algebra, eigen values and eigen vectors, rank, solution of linear equations – existence and uniqueness.

Calculus: Mean value theorems, theorems of integral calculus, evaluation of definite and improper integrals, partial derivatives, maxima and minima, multiple integrals, line, surface and volume integrals, Taylor series.

Differential Equations: First order equations (Linear and Nonlinear), higher order linear differential equations with constant coefficients, method of variation of parameters, Cauchy's

and Euler's equations, initial and boundary value problems, partial differential equations and variable separable method.

Complex Variables: Analytic functions, Cauchy's integral formula: Cauchy's integral theorem, Taylor's and Laurent' Series, residue theorem.

Probability and Statistics: Probability, Joint and conditional probability, discrete and continuous random variables, probability distribution and density functions. Exponential, Poisson, normal and Binomial Distributions Functions. mean, mean square and standard deviation.

Numerical Methods: Solutions of non-Linear equations, single and multi-step methods for differential equations.

Section-II

Networks:

Network solution methods: Nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time-domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks.

Electronic Devices: Energy bands in silicon, intrinsic and extrinsic silicon. Carrier transport in silicon: diffusion current, drift current, mobility, and resistivity. Generation and recombination of carriers. p-n junction diode, zener diode, tunnel diode, BJT, JFET, MOS capacitor, MOSFET, LED, P- I -N and avalanche photo diode, Basics of LASERs.

Analog Circuits: Small Signal Equivalent circuits of diodes, BJTs, MOSFETs and analog CMOS. Simple diode circuits, clipping, clamping, rectifier. Biasing and bias stability of transistor and FET amplifiers.

Amplifiers: Single-and multi-stage, differential and operational, feedback, and power. Frequency response of amplifiers. Simple op-amp circuits. Filters. Sinusoidal oscillators; criterion for oscillation; single-transistor and op-amp configurations. Function generators and wave-shaping circuits, 555 Timers. Power supplies.

Section-III

Digital circuits: Boolean algebra, minimization of Boolean functions; logic gates; digital IC families (DTL, TTL, ECL, MOS, CMOS).

Combinatorial circuits: arithmetic circuits, code converters, multiplexers, decoders, PROMs and PLAs.

Sequential circuits: latches and flip-flops, counters and shift-registers. Sample and hold circuits, ADCs, DACs. Semiconductor memories: ROM, SRAM, DRAM.

Microprocessor (8085): architecture, programming, memory and I/O interfacing.

Signals and Systems: Definitions and properties of Laplace transform continuous-time and discrete-time Fourier series, continuous-time and discrete-time Fourier Transform, and FFT, z-transform. Sampling theorem.

Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay. Signal transmission through LTI systems.

Control Systems: Basic control system components; block diagrammatic description, reduction of block diagrams. Open loop and closed loop (feedback) systems and stability analysis of these systems. Signal flow graphs and their use in determining transfer functions of systems; transient and steady state analysis of LTI control systems and frequency response.

Tools and techniques for LTI control system analysis: root loci, Routh-Hurwitz criterion, Bode and Nyquist plots.

Section-IV

Communications: Random signals and noise: probability, random variables, probability density and distribution functions, Moments, autocorrelation, power spectral density.

Analog communication systems: Amplitude and Angle modulation and demodulation systems, spectral analysis of these operations, superheterodyne receivers; elements of hardware realizations of analog communication systems; signal-to-noise ratio (SNR) calculations for amplitude modulation (AM) and frequency modulation (FM) for low noise conditions. Fundamentals of information theory and channel capacity theorem.

Digital communication systems: Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM)

Digital modulation schemes: amplitude, phase and frequency shift keying schemes (ASK, PSK, FSK), QAM, matched filter receivers, bandwidth consideration and probability of error calculations for these schemes. Basics of TDMA, FDMA and CDMA and GSM.

Electromagnetics: Maxwell's Equations: differential and integral forms and their interpretation, boundary conditions, wave equation, poynting vector; plane waves and properties: reflection and refraction, polarization, phase and group velocity, propagation through various media, skin depth; Transmission Lines: equations, characteristic impedance, impedance matching, impedance transformation, S-parameters, Smith chart: Waveguides: modes, boundary conditions, cut-off frequencies, dispersion relations. Antennas: antenna types, radiation pattern, gain and directivity, return loss.

9. ELECTRONICS AND INSTRUMENTATION ENGINEERING (DEGREE LEVEL)

1. **Fundamentals:** Coulomb's law – Ohms law – Faradays laws of electromagnetic induction, Kirchhoff's laws, Ampere's law Resistance, Capacitance and Inductance, Graph, tree and links – Loop currents, node voltages two port networks, Z, Y and Hybrid parameters. Alternating currents, RMS value, formfactor, R.L.C. in AC Circuits power; and power factor, network theorems – Harmonic analysis.
2. **Analog Electronics**: Characteristics and applications of diode, Zener diode, BJT and MOSFET; small-signal analysis of transistor circuits, feedback amplifiers. Characteristics of ideal and practical operational amplifiers; applications of op-amps: adder, subtractor, integrator, differentiator, difference amplifier, instrumentation amplifier, precision rectifier, active filters, oscillators, signal generators, voltage-controlled oscillators and phase-locked loop.555 timer and applications
3. **Digital Electronics:** Combinational logic circuits, minimization of Boolean functions. IC families: TTL and CMOS. Arithmetic circuits, comparators, Schmitt trigger, multi-vibrators, sequential circuits, flipflops, shift registers, timers and counters; sample-and-hold circuit, multiplexer, analog-to-digital (successive approximation, integrating, flash and sigma-delta) and digital-to-analog converters (weighted R, R-2R ladder and current steering logic). Characteristics of ADC and DAC (resolution, quantization, significant bits, conversion/settling time); basics of number systems.
4. **Electrical and Electronic Measurements:** Indicating instruments, D-Arsonval type Galvanometer, Vibration Galvanometer, Ballistic Galvanometer, Measurement of resistance, AC Potentiometers, Wheatstone Bridge, Kelvin's bridge, AC Bridges, Maxwell's, Heaviside and Schering bridges.
   Cathode Ray Oscilloscope and its applications, Electronic Voltmeters – Balanced bridge type, transistor Voltmeter, Chopper amplifier type Voltmeter, High Frequency measurements.
5. **Process Instrumentation:** Fundamentals of Instrumentation, Static and dynamic characteristics of Measurement Systems. Error and uncertainty analysis. Statistical analysis of data and curve fitting. Transducers – Primary and Secondary –Classification of transducers, Basic transducer theory for the measurement of displacement, Temperature, Flow, Level measurement, Force and torque,Density and viscosity, Humidity- Nuclear instrumentation, Smart sensors, IR sensors, Motion detection sensors, accelerometer sensors, Gyroscope sensors.
6. **Control Systems and Process Control:** Feedback principles. Signal flow graphs.Transient Response, steady-state-errors. Routh and Nyquist criteria. Bode plot, root loci. Time delay systems. Phase and gain margin. State space representation of systems. Mechanical, hydraulic and pneumatic system components. Synchro pair, servo and step motors. On-off, cascade, P, P-I, P-I-D, feed forward and adaptive control.
7. **Analytical, Optical and Biomedical Instrumentation:** Mass spectrometry. UV, visible and IR spectrometry. X-ray and nuclear radiation measurements. Optical sources and detectors, LED, laser, Photo-diode, photo-resistor and their characteristics. Interferometers, Basics of fiber optics. Biomedical instruments, EEG, ECG and EMG. Clinical measurements. Ultrasonic transducers and Ultrasonography. Principles of Computer Assisted Tomography.

8. **Embedded Systems:** Microprocessor and microcontroller applications, memory and input-output interfacing; basics of data acquisition systems, basics of distributed control systems (DCS) and programmable logic controllers (PLC).

10. FOOT WEAR TECHNOLOGY (DEGREE LEVEL)

- Classification of Footwear, Leather goods, Garments based on construction, utilization, style-Upper Parts of Footwear, Bottom Parts of Footwear.
- Anatomy of Feet-Bones, Joints, Arches of the Foot –Changes during Growth-Functions of the Foot- Common Foot Troubles. – Reasons for foot problems – Deformed feet – Remedy.
- Foot Measurements- Foot drafting – Length and Girth Measurements-Different Footwear Sizing systems- Fittings and Multi Fittings-Conversion from one Sizing system to other system-Functions of the Feet.
- Lasts-Materials-classification of Lasts-Parts of the Last-Last Measurements –Last Terms-Last Functions-Comparison of Last and Feet-Different type of Hinges-Last Manufacturing- Grading.
- Footwear Designing -7 Basic Styles of Footwear- Mean form preparation-Footwear Styling-Design and Pattern Development of Sandals, Derby, Oxford, Slip on, Court shoe, Moccasin, Ankle Boot, Calf Boot, Knee boot, Grading – different grading systems – equipment used for grading- Footwear CAD software Packages, Different Functions available in Software.
- Clicking- Qualities required in a Clicker-Characteristics and Variation in Leather-Manufacturing/Quality Requirements-Methods of Clicking leather, Synthetics-Leather Measurement Systems.
- Pre fitting and Closing-Splitting-Identification Markings-Stitch markings-Press Punching-Perforating-Embossing-Skiving-Types of Skiving –Machines for Pre fitting and Closing Operations –Reinforcements-Top line and Edge Treatments-Stitching Machines-Lockstitch-Chain Stitch-Types of Seams-Decorative Stitching-Boxing and Barring Stitching-Eye letting- Threads –Needles-organizing of Closing.
- Footwear Materials-Different Type of Leathers -Soles-Insoles-Toe Puff- Stiffeners-Heels-Shanks-Adhesives-Threads-Needles- Linings-Synthetic Upper materials-Coated Fabrics-Poromerics-Knitted Fabrics-Woven, Non Woven Fabrics-Comparison of Leather and Synthetics- Leather Boards-Reinforcement Materials-Grinderies-Thermo Plastics, Comparison of Leather and non Leather Footwear .
- Bottoming operations-Conditioning of Upper before Lasting-Toe puff attaching-Counter stiffener attaching and Counter Moulding-Forepart lasting-Seat and Side Lasting-Heat Setting-Hot air blowing-Pounding –Wrinkle Chasing- Leather& Synthetic Upper Preparation for Sole Attaching , Leather& Synthetic Sole Preparation for Sole Attaching -Adhesive application- Sole attaching- heel attaching and Heel Nailing.
- Finishing Operations-Sole and Heel Finishing Operations-Heel Paring-Heel Scouring-Edge Paring- Edge Inking- Edge Setting- Heel Inking- Heel Burnishing- Sole Buffing – Sole Staining – Sole Finishing- Heel seat Wheeling- Other Sole and Heel Finishing Operations-Machines Used.
- Upper Finishing operations- upper Cleaning- Upper Conditioning- Upper Filling- Upper Dressing- Different Materials used- Different Machines Used- Finishing of Suede and Nubuck Leathers. Combined Finishing Machines-Making of Prefinished Leather Soles.
- Different Footwear Construction Methods-Cemented Construction- Veldtschoen Construction - Machine Welted Construction- Californian Slip Lasting Construction-String Lasting Constructions- Direct Vulcanizing Construction- Injection Moulding of PVC construction - Injection Moulding of PU Construction- Machines Used.

- Specialty Footwear –Leather Safety Shoes, Boots, Mining Safety shoes, Boots-Safety Rubber Canvas Boot for Miners-Steel Toecaps- Sports Footwear- Running Spikes, Track Shoe, Football boots, Tennis Shoes, Gymnastic Shoes, Orthopedic Footwear-Foot Problems-Materials used-Modifications required for different Foot Problems, Children Footwear Modifications , Casting the foot for Custom shoes.
- Testing – Sampling Position of Leather for Testing- Conditioning of Leather for Testing , Testing of Physical properties like tensile strength - % elongation at break stitch tear,

tongue tear strength, Flexural endurance test, Lasto meter tests, Grain crack Index, Real Density tests, Testing of Shrinkage Temperature, Absorption of Water, Dynamic Water Proofness Tests, Dry and Wet Rub Fastness test, Air and water Vapour Permeability tests, Leather Finish Tests, Abrasion Tests, Testing of Sole Materials, Various Types of Adhesive Failures-Sole Adhesion Tests, Tests on Adhesive Bond-Bond Development-Testing of Threads, Laces, Zips, Buckles- above test methods and their importance.

- Quality Control- Quality points to be inspected after Clicking, Splitting, Skiving, Upper Making, Lasting, Sole attaching, Final Inspection of Footwear Manufacturing.
- Leather Goods and Garments- materials used- Pattern Making and Fabrication Procedure of Small Leather Goods, Ladies bags, Brief Cases , Zip Folio Cases, -Fabrication of Suitcase, Holdals, Attaache Cases, -Garment Leathers, Material Used in Garment Fabrications- Basic Sleeve Block, Collars.
- Hand Tools used in Footwear Manufacturing, Leather Goods and Leather Garments Manufacturing- Carving and Stamping Tools, Finishing Tools.
- Foot wear Machines – Operating Principle of Clicking Machines, Pre Fitting Machines, Closing Machines, Lasting Machines, Bottoming Machines, Finishing Machines.
- Costing- Costing of Foot wear, Leather Goods, Garments- Different Methods used for Material Consumption Calculations.
- Leather Making-Operations involved in making Leather, Classification of Leather Based on Raw Material, Type of Tanning, Type of Finish- Defects in Leather- Selection of Leather for Different Use.

11. GEOLOGY (POST GRADUATE LEVEL)

1. Geomorphology & Field Geology: Fundamental concepts of geomorphology, Geomorphic processes, Weathering, soils, mass wasting, Streams and valleys, drainage patterns and their significance, groundwater, glacial cycle, wind, lakes, seas, earthquakes, volcanoes and mountains, application of geomorphology to various fields of earth sciences.

Field Geology: Toposheet, geological map, field work and sampling, compass, geological mapping procedures. Surveying Principles and methods surveying, chain survey, prismatic survey, plane table survey and theodolite survey. Dumpy's level.

2. Crystallography, Mineralogy& Optical Mineralogy: External symmetry of crystals: symmetry elements, classification of crystals into systems and classes, diffraction of crystals, Braggs' law. Physical properties of minerals, classification of minerals, structural and chemical principles of crystals / minerals, physical and optical characters and paragenesis of mineral groups- Olivine, pyroxene, amphibole, feldspars, quartz, chlorite, mica, spinel, epidote and garnet groups, optical properties of common rock forming silicate minerals.

3. Structural geology and Geotectonics: Stress-strain relationship of elastic, plastic and viscous materials. Principles of geological mapping, measurement of strike and dip, Structural analysis of folds, cleavages, lineation's, joints, and faults, superposed deformation, mechanism of folding and faulting, Unconformities, structural behavior of igneous rocks, diapirs and salt domes, fundamentals of petrofabric analysis.

Earth and solar system, planetary evolution of earth and its internal structure, Heterogeneity of the earth's crust, Major tectonic features of the oceanic and continental crust, Continental drift, mid oceanic ridges, deep sea trenches, continental shield areas and mountain chains. Paleomagnetism, seafloor spreading and plate tectonics, Island arcs, oceanic islands and volcanic arcs, isostacy, orogeny, geosynclines, and seismic belts of the earth, seismicity and plate movements, Geodynamics of the Indian plate.

4. Palaeontology & Stratigraphy: Micro-palaeontology, origin and evolution of life, classification and uses of micro fossils. Plant fossils: Gondwana flora and their significance, Invertebrate and vertebrate palaeontology, fossils and their morphology, distribution with geological time period.

Principles of Stratigraphy, geological time scale, modern methods of stratigraphic correlation, Precambrian Stratigraphy of India, Stratigraphy of the Palaeozoic, Mesozoic and Cenozoic formations of India. Gondwana system and Gondwana land, origin of Himalaya and evolution of Siwalik basin, Deccan traps, Quaternary Stratigraphy, rock record, paleoclimates and paleogeography.

5. Igneous Petrology & Geochemistry: Origin of magmas, phase equilibrium in igneous systems, Bowen's reaction principle, Magmatic evolution and differentiation, Structures and

textures of igneous rocks, Classification of igneous rocks, Magmatism and tectonics, Igneous rock suites- Ultramafic rocks, Basic rocks, Intermediate rocks, Acidic rocks and Alkaline rocks.

Geochemistry, Elements, Meteorites, Primary geochemical differentiation of earth, Goldschmidt's geochemical classification of elements, Periodic table, Magmatism as geochemical process, Major elemental distribution in igneous rocks, Trace element distribution in igneous rocks, Sedimentation as a geochemical process, Metamorphism as a geochemical process, Isotope geochemistry, Atmospheric geochemistry.

6. Metamorphic Petrology & Thermodynamics: Metamorphism, factors and kinds of metamorphism and metamorphic processes; Classification of metamorphic rocks and nomenclature, Structures and textures, zones, grades, and facies of metamorphism, Phase relations and phase diagrams for metamorphic mineral assemblages, processes and products of Contact, Regional, thermal, dynamo-thermal metamorphisms, metasomatism, granitization, typical Indian rocks.

Objectives of thermodynamics, inter-relationship between petrogenetic processes and thermodynamics, Role of thermodynamics in geochemistry, Phase rule, 'pressure-temperature-depth relations' among various metamorphic facies and ultra metamorphism, Paired metamorphic belts, Metapelitic and metabasic minerals and mineral assemblages, First law of thermodynamics, Second law of thermodynamics, P-T diagrams, geothermobarometry, pressure(P)-temperature(T)-time(t) paths.

7. Sedimentology & Petroleum Geology: Sedimentary environments- fluvial, glacial, eolin and lacustrine environments, transitional environments including deltaic, beach and tidal flats, marine environments including shelf (clastic and non-clastic) and deep sea sedimentary environment, Evolution of sedimentary basins, Tectonic setting of sedimentary basins.

Petroleum Geology, Constitution and Genesis of hydrocarbons, conversion of organic matter to petroleum, variety of petroleum hydrocarbons and gas hydrates, Reservoir rocks, Migration and accumulation of oil, structural traps, stratigraphic traps and combination traps, salt domes, methods of Exploration and exploitation of petroleum, Geographic and stratigraphic distribution of oil and gas, global distribution, petroliferous basins in India.

8. Ore Genesis, Mineral Deposits and Mineral economics: Modern concept of ore genesis, principal ore mineral groups, plate tectonics and ore deposits, ore textures, Paragenetic sequences and zoning in metallic ore deposits, ore microscopy, application of geothermobarometry, fluid inclusions in ores, Role and application of stable isotopes in ore genesis, Petrological ore associations with Indian examples, orthomagmatic ores of mafic-ultramafic association, diamonds in kimberlites, REE in carbonatites, chromite in chromitites and basic rocks, PGE in ultramafic and basic rocks, Chemical and clastic sedimentation, stratiform and stratabound ore deposits (Mn, Fe, non-ferrous ores), placer concentrations, Ores related to weathering and weathered surfaces, laterite, bauxite and manganese nodules.

Study of geology, nature of occurrence and the genesis of the following ore deposits with special reference to India- Iron, Chromite, Manganese, Copper, gold, Lead and Zinc, Bauxite, Magnesite, Barites, Mica, Asbestos, decorative stones, *Mineral based Industries:* Iron and steel; *Refractories:* Ceramic, electrical and insulators, glass.

Stragetic, critical and essential minerals. Indias status in mineral production. Change in pattern of mineral consumption, National Mineral Policy. Mineral concession rules, Marine mineral resources and law of sea, Conservation and substitution of minerals.

9. Environmental Geology: Concepts and principles, Natural hazards, preventive/precautionary measures-floods, landsides, earthquakes, rivers and coastal erosion. Impact assessment of anthropogenic activities such as urbanization, open-cast mining and quarrying, river-valley projects, disposal of industrial radioactive waste, excess withdrawal of groundwater, use of fertilizers, dumping of ores, mine waste and flyash, Organic and inorganic contamination of groundwater and their remedial measures, soil degradation and remedial method, Environmental protection-legislative measures in India, factors for groundwater subsidence.

10. Engineering Geology Mechanical properties of rocks and soils, Geological investigations for river-valley projects-dams and reservoirs, tunnels-types, methods and problems, Bridges-types and foundation problems, shoreline engineering, landslides- classification, causes, prevention and rehabilitation, Earthquake resistant structure, Problems of groundwater in engineering projects and Geotechnical case studies of major projects in India.

11. Mineral Exploration and Fuels: Methods of surface and subsurface exploration, prospecting for economic minerals and fuels-drilling, sampling, and assaying. Geophysical techniques – gravity, electrical, magnetic, air borne, and seismic surveys, Instrumental techniques of detection and measurement of radioactivity, Radioactive methods for prospecting and assaying of mineral deposits. Geomorphological and remote sensing techniques,

Geobotanical and geochemical methods. Bore hole logging and survey. Origin of coal, Stratigraphy of coal measures, Fundamentals of coal petrology, peat, lignite, bituminous and anthracite, Industrial application of coal, Indian coal deposits,

Origin, accumulation, migration and entrapment of natural hydrocarbons, characters of reservoir rocks, structural, stratigraphic and mixed traps, geographical and geological distribution of petroliferous basins of India. Gas hydrates and Coal Bed Methane occurrences, Mineralogy and geochemistry of radioactive minerals, distribution of radioactive minerals in India, Radioactive methods in petroleum exploration-well logging techniques, nuclear waste disposal-geological constraints.

12. Hydrogeology: Origin of water, Hydrological cycle, water table, Rock properties affecting groundwater, Types of aquifers, Porosity, permeability, specific yield and retention, hydraulic conductivity, trasmitssivity, storage and storage coefficient. Water level fluctuation and causative factors, methods of pumping tests and analyses, evaluation of aquifer parameters, artificial recharge of groundwater, groundwater legislation, groundwater quality and groundwater pollution, arsenic and fluoride problems, quality criteria for groundwater use, salt water intrusion in coastal aquifers and remedial methods, surface geophysical methods-seismic, gravity, geoelectrical and magnetic, subsurface geophysical methods-well logging for delineation of aquifers and estimation of water quality, Watershed management.

13. Photo Geology, Remote Sensing, GIS and GPS: Elementary idea about photogeology: electro-magnetic spectrum, types & geometry of aerial photographs; factors affecting aerial photography; Fundamentals of remote sensing; remote sensing systems; remote sensing sensors; signatures of rocks, minerals and soils. Application of remote sensing in geosciences and geomorphological studies, Types of Indian and Foreign Remote Sensing Satellites, Digital image processing; fundamental steps in image processing; elements of pattern recognition and image classification, Geographic Information System (GIS), components of GIS; product generation in GIS; tools for map analysis; integration of GIS with remote sensing. Geographic positioning system (GPS), scope of GPS, advantages and uses of GPS in different fields.

14. Mining Geology: Alluvial, open- pit and underground mining methods; mine organization and operation; mine hazards. Sampling techniques, drilling methods, estimation of ore reserves, Cost of mining; future costs and profits; life of mine; present value of mine. Environmental issues with mining.

12. LETTER PRESS (PRINTING TECHNOLOGY) (DEGREE LEVEL)

Printing Processes, Paper & Ink Technology

All Printing Processes – Applications, Principles, Properties and Characteristics,

Paper – Raw materials used in Paper, Pulp Making, Materials used in Pulp Making, Manufacturing of Paper, Recycling of Paper, Physical Characters of Paper & Board, Properties of Paper, Instruments used to measure properties of paper and Boards, Paper testing Methods, Problems faced with paper

Ink – Ingredients, Manufacturing of Ink, Properties of Ink, Drying Mechanism, Inks used in Different Printing Processes and their Properties, Ink Problems

Offset Process, Gravure Process & their Surface Preparation

Offset Printing Process & their Surface Preparation – Classification of Offset Printing, Sheet fed –Machine Structure and Types, Web Offset – Machine Structure and Types, Auxiliary equipment, Surface Preparation – Types of Planographic Plates, Surface chemistry of Plates, Plate making materials, Computer to plate technology, Problems and remedies.

Gravure Process –Applications of Gravure, Machine Structure and Types, Gravure Cells, Construction of Gravure Cylinder, Etching and Engraving techniques, Gravure cylinder surface finishing techniques, Slitting Operations, Materials used for Gravure Cylinder, Solvents used Problems and remedies.

Flexography, Screen Printing & their Surface Preparation

Flexography –Aniline Printing, Flexography Machine Structure and Types, and Flexography Plates – Classification, Materials used, Making of Plates, Problems and remedies.

Screen Printing – Frames, Screen - Treatment, Materials used, Squeegee, Stencil Making and its Methods, Inks& Solvents used in Screen Printing, Drying, Printing Machinery Problems and remedies.

Pre-Press Technology

Basic of Computers, Desk Top Publishing, Electronic Image, File Formats, Printers Design, Colour Science, Colour Separation, Colour Measuring Instruments, Typography, Print Planning, Colour Management

Print Finishing, Packaging & Converting

Print Finishing – Book Binding & its Classification, End Papers, Warehouse, Covering Materials, Securing Materials, Reinforcing Materials, Adhesives, Different Finishing Operations, Different Equipment’s used and Automation in Post-Press.

Packaging & Converting – Functions, Criteria, Types, Role of Designing in Packaging, Carton Making, Manufacturing of Corrugated Boxes, Rigid Boxes, and other Materials used for Packaging, Different Converting Processes, Bar Coding

Specialty Printing Technologies, Advertising & Quality Control

Specialty Printing Technologies – Non-Impact Printing Technologies and their Mechanism, E Print – E Books, E Paper & Inks, Security Printing Processes, Types of Security Paper & Inks& its Manufacturing, E-Publishing

Advertising – Different Medias, Types of Print Media, Advertisement creation and Promotion, Advertising Ethics, Legal Issues, Copy rights, Elements of Marketing, Channel distribution

Quality Control – Objectives, Functions, Benefits, Quality control as Management tool, Quality control in all areas of Printing, Print Quality checking devices, Standards and their tolerances, Different ISO's.

13. MECHANICAL ENGINEERING (DEGREE LEVEL)

Section I: Applied Mechanics and Design

Engineering Mechanics: Free-body diagrams and equilibrium; Friction, rolling friction, belt – pulley, screw jack, wedge, Trusses and Frames; Virtual work; Kinematics and Dynamics of Particles and Rigid Bodies in Plane Motion; Impulse and Momentum (Linear and Angular) and Energy Formulations; Impact.

Strength of Materials: Stress and Strain, Stress-Strain Relationship and Elastic Constants, Poisson's Ratio; Mohr's Circle For Plane Stress and Plane Strain; Thin Cylinders; Shear Force and Bending Moment Diagrams; Bending And Shear Stresses; Deflection Of Beams; Torsion Of Circular Shafts; Euler's Theory Of Columns; Energy Methods; Thermal Stresses; Testing Of Materials with Universal Testing Machine (UTM); Hardness And Impact Strength.

Theory of Machines: Displacement, Velocity and Acceleration Analysis of Plane Mechanisms; Dynamic Analysis of Slider-Crank Mechanism; Gears and Gear Trains; Flywheels, Gyroscope and Governors; Balancing of Reciprocating and Rotating Masses.

Vibrations: Free and Forced Vibration of Single Degree of Freedom Systems, Effect of Damping; Vibration Isolation; Resonance; Critical Speeds of Shafts.

Machine Design: Design For Static and Dynamic Loading; Failure Theories; Fatigue Strength; S-N Diagram; Design of Machine Elements such as Bolted, Riveted and Welded Joints, Shafts, Spur Gears, Rolling and Sliding Contact Bearings, Springs, Brakes and Clutches.

Section II: Fluid Mechanics and Thermal Sciences

Fluid Mechanics: Fluid Properties; Fluid Statics, Manometry, Buoyancy, Forces on Submerged Bodies, Stability of Floating Bodies; Fluid Acceleration; Differential Equations of Continuity and Momentum; Bernoulli's Equation; Viscous Flow of Incompressible Fluids, Boundary Layer, Elementary Turbulent Flow, Flow Through Pipes, Head Losses in Pipes and Bends.

Heat-Transfer: Modes of Heat Transfer; One Dimensional Heat Conduction, Resistance Concept, Electrical Analogy, Fins; Unsteady Heat Conduction, Dimensionless Parameters in Free and Forced Convective Heat Transfer, Various Correlations for Heat Transfer in Flow Over Flat Plates and Through Pipes, Effect of Turbulence; Radiative Heat Transfer, Black And Grey Surfaces, Shape Factors, Network Analysis, Heat Exchanger Performance, LMTD and NTU Methods.

Thermodynamics: Thermodynamic systems and processes; properties of pure substances, behavior of ideal and real gases; zeroth and first laws of thermodynamics, calculation of work and heat in various processes; second law of thermodynamics; thermodynamics property, availability and irreversibility; thermodynamic relations.

Power Engineering: Air compressors-Reciprocating and rotary compressors;Rankine, Brayton Cycles with Regeneration, Inter cooling and Reheat.

I.C. Engines: Air-standard Otto & Diesel Cycles, Combustion in S.I. & C.I. Engines, Performance & Testing of internal combustion engines.

Refrigeration and Air-Conditioning: Vapour Refrigeration Cycle, Heat Pumps, Gas Refrigeration; Reverse Brayton Cycle; Moist Air: Psychrometric Chart, Basic Psychrometric Processes.

Turbomachinery: Pelton Wheel, Francis and Kaplan Turbines, Impulse and Reaction Principles, Velocity Diagrams.

Section III: Materials, Manufacturing and Industrial Engineering

Engineering Materials: Structure and Properties of Engineering Materials, Heat Treatment, Stress-Strain Diagrams for Engineering Materials, Iron-carbon diagram.

Metal Casting: Design of Patterns, Moulds and Cores; Solidification and Cooling; Riser and Gating Design.

Metal Forming: Plastic Deformation and Yield Criteria; Fundamentals of Hot and Cold Working Processes; Load Estimation for Bulk (Forging, Rolling, Extrusion, Drawing) and Sheet (Shearing, Deep Drawing, Bending) Metal Forming Processes; Principles of Powder Metallurgy.
Joining Processes: Principles (Gas, Arc, Resistance and Solid State) of Welding, Brazing, Soldering; Adhesive Bonding.
Machining and Machine Tool Operations: Mechanics of Machining; Basic Machine Tools; Single and Multi-Point Cutting Tools, Tool Geometry and Materials, Tool Life and Tool Wear; Economics of Machining; Principles of Non-Traditional Machining Processes; Principles of Work Holding Devices, Principals of Jigs and Fixtures.
Metrology and Inspection: Limits, Fits and Tolerances; Linear and Angular Measurements; Comparators; Gauge; Interferometry; Form and Surface Finish Measurement; Alignment and Testing Methods; Tolerance Analysis in Manufacturing and Assembly.
Computer Integrated Manufacturing: Basic concepts of CAD/CAM and their integration tools.
Production Planning and Control: Forecasting Models, Aggregate Production Planning, Scheduling, Materials Requirement Planning.
Inventory Control: Deterministic Models; Safety Stock Inventory Control Systems.
Operations Research: Linear Programming, Simplex Method Transportation, Assignment, Simple Queuing Models, PERT and CPM.

14. METALLURGICAL ENGINEERING (DEGREE LEVEL)

MINERAL PROCESSING AND PRINCIPLES OF EXTRACTIVE METALLURGY:

Ore Dressing, Sampling of ores, Communition: sizing, Concentration operations, Classification, Jigging, Flotation; Basics of Pyrometallurgy, Hydrometallurgy and Electrometallurgy.

PHYSICAL METALLURGYAND HEAT TREATMENT:

Phase diagrams, Crystal structures, Solidification of metals , Iron carbon diagram, Metallography, Heat treatment process, CCT diagrams, hardenability; Superalloys, shape memory alloys – classification, heat treatment, properties and applications.

METALLURGICAL THERMODYANAMICS:

Thermodynamics: concepts of system, First Law of Thermodynamics, Kirchhoff's equation; Second Law and third law of Thermodynamics, Enthaphy and entropy, Boltzmann equation. Energy Functions: Helmholtz and Gibbs energy change;. Application of the Clausius – Clapeyron equation; Solutions: Composition, Concept of chemical potentia, partial molal quantities, Gibb's - Duhem equation; Application of Ellingham diagrams to process metallurgy.

MECHANICAL METALLURGY:

Plastic Deformation in Metals and Alloys: concept of dislocation; slip and twinning, theories of fracture, Griffith's theory of brittle fracture, ductile fracture; Hardness tests; Tension Test, stress-strain curves, DBTT curve ,Fatigue Test, Creep and Stress Rupture.

IRON & STEEL MAKING:

Principles of Iron making, Preparation of iron ores; Iron making through blast furnace, Physical chemistry of Iron making, Control of C, Si, S, P in pig iron. Blast furnace Slags and its properties; Blast furnace operations and difficulties, modern trends in blast furnace; steel making: Principles and types of deoxidation, fundamentals of direct reduction, applications of DRI. Coal based DR processes; Smelting Reduction Processes.

NON FERROUS EXTRACTIVE METALLURGY:

Copper: Matte smelting, converting; Fire refining; Electrolytic refining; Hydro- Metallurgical copper extraction; Zinc production in retort process and Blast furnace; Lead: Blast furnace smelting, Refining of lead bullion. Aluminium: Bayer process, Hall - Heroult process, Anode effect; Magnesium: Production of a hydrous Magnesium chloride from seawater, Pidgeon and Handspring processes; Titanium: Upgrading of ilmenite, chlorination of titanium, Kroll's process; Uranium: Acid and alkali processes for digestion of uranium ores, Purification of crude salt, Production of reactor grade UO_2 and uranium.

MECHANICAL WORKING OF METALS:

Stress and Strain Relationship for Elastic Behavior: State of stress in two dimensions. Mohr's circle of stress in two dimensions, Elements of Theory of Plasticity; Fundamentals of Metal Working: Classification of forming processes; forging: Classification, Forging defects, Rolling of Metals and Extrusion.

POWDER METALLURGY OF METALS:

Importance of powder metallurgy, Characterization of Powders: Compaction, Sintering. Mechanisms of solid state and liquid phase sintering; Testing and quality control, metallic and ceramic P/M components; Applications of P/M products.

NON - METALLIC MATERIALS:

Definition and classification of nonmetallic materials, Ceramics: Introduction, classification, structure, and applications of ceramics; Glasses: Classification and applications; Composites: Manufacturing of Polymer matrix, metal matrix, and ceramic matrix composites.

MATERIAL PROCESSING (CASTING & WELDING):

Types of Foundries, Patterns and allowances, Moulding materials, Moulding Processes, Casting Methods, Melting and Solidification, casting defects ; welding processes: Gas Welding, Arc Welding processes, MMAW, GTAW, MIG, SAW and Resistance Welding, Metal Joining Techniques, Weldability, Microstructure of welds.

FURNACE TECHNOLOGY & PYROMETRY:

Steady State Heat Transfer;Furnaces Characteristic features of vertical shaft furnaces, reverberatory furnaces, Electric Arc and Induction furnaces. Pyrometry.

NON DESTRUCTIVE TESTING:

Visual methods**;** Penetrant flaw detection, Magnetic particle testing, Eddy current testing, ultrasonic testing and Radiographic testing methods.

SUPER ALLOYS*:*

Classification and selection of superalloys, Relationship of properties to Microstructure in superalloys**;** Melting of Superalloys; Principles and practices of vacuum Induction Melting and Vacuum Arc melting Forming Methods.

15. PACKAGING TECHNOLOGY (DEGREE LEVEL)

Packaging basics

History and concept of packaging, Ancient Modern History of food packaging – packaging evolution – super market- its Chronological developments , its need and role in society, Physical and Physio-chemical characteristics of a product, functions of packaging, components, various types of hazards, packaging laws and regulations ,corrosion prevention in packaging including preventive coating methods.

Product compatibility –Permeability, definition of migration and types of migrations, laws on diffusion, Ficks Law and Barriers law. Plasticizers, their types, functions and applications, Shelf life, its controlling factors, testing procedures and devices.

Packaging materials

Properties , types , conversion processes, applications and quality control of primary packaging materials such as paper, paper board, CFB, plastics and plastic films, elastomers glass, metals, composite containers, laminations, wood and ancillary materials like adhesives, cushioning, labels, labeling including marking & bar codes seals, closures & dispensing devices, cylindrical and rectangular shipping packages, flexible shipping packages, pallets & unit loads.

Testing of packaging materials

Surface, physical, chemical, printability tests, compatibility and shelf life studies, testing methods including identification of plastics, performance testing methods for evaluation of transport packages, mechanical tests - drop test- vibration test - compression test - impact test - rolling test, climate test: rain test - sound and dust tests - salt spray test - fungus resistance tests.

Packaging of pharmaceuticals

Concept of drug, general aspects of drug package, basic terminology, FDA , ampoule, vial, caplet , capsule, DMF, parenteral drug, USP, BP, CRP ,classification of pharmaceuticals , preparation of various pharmaceutical products, spoilage mechanisms, various hazards, national and international regulators and pharmacopoeias, labels, leaflets, barcodes ,track and trace and anti-counterfeit methods, materials used for pharmaceutical packaging- glass, metals, plastics, plastic films, elastomers ,paper and paper board-their properties advantages and various applications, fabrication and filling of various containers, container filling and

sterilization processes. Closure by adhesives, closure by separate devices, cans , bottles ,jars, tubes, closure materials for pharmaceutical products, child resistant packaging, testing procedure, various primary and secondary packages used for pharmaceuticals including medical administrative devices, concept of QbD in package development.

Product packaging

Packaging of dairy, fresh, frozen and irradiated foods, confectionery, beverages, horticultural crops, engineering goods, electronic goods, soaps and detergents, desired attributes of a soaps & detergents, fertilizers, pesticides, chemicals, textiles and handicrafts, cosmetics and personal care, aerosols, dangerous goods, major factors governing the selection of packaging materials & packages, economics, transport, storage and legal obligations.

Packaging design

Objectives of package design, functions and conditions, safety factors, impact design criterion, horizontal impact, vertical cushioning displacement, design cushioning theory, application of force deformation curves, load curves, cushioning factors and reliability, economics of optimum cushioning - Use of tension spring mounting systems, Full suspension package, non-linear energy absorption load factors for vertical drops, design considerations, Use of rubber shear mounts -physical concept of flexible mounting systems, natural frequency, - Materials, specifications, plywood containers, typical ply wood container analysis, handling loads, stacking loads - Bottle design, special requirement for bottle performance, manufacturing and filling, specification. Environmental concerns - Glass container design - Container shape and dimensions - Marketing and sales factors. Color, shape, labels, decoration, surface conditions. Scope of packaging field, role of shipping container - clear & legible communication, legal aspects of packaging graphics – designers approach to clear & legible communications. Packaged product information – government & consumer issues.

Package printing

Type Production & Camera Work, Letter Press - Offset Lithographic Printing, Reprography, Rotogravure and Screen Printing, Flexo Graphic, Digital Printing and Proofing Methods

Process color work – electronic color separation, packaging graphics marketing communication roles –topography and copy, color, design forms, UPC symbolic and other penal copy. Evolution - basics, printing inks - ink controls - presses - applications - advantages and disadvantages - color laser-ink jet prints, proofing methods. Principles of electronic, computer and laser operated devices used in printing and modern developments.

Packaging processes and machines

Various methods of filling and sealing of liquid, semi liquid and dry products – bottling, canning & machineries involved, wrapping and bundeling, bags manufacture, filling and closing ,types of bags ,BIB packages, system packaging, selection of appropriate system, salient features of different types of systems ,lined carton system ,coated and laminated carton system ,stand up pouches, aseptic filling and packaging systems. Vacuum packaging, gas packaging, strip, skin and blister packaging machines-blow & injection moulding machines, metallization, thermo forming, and form fill and seal machines

Packaging management and economics: Introduction, importance of economy in production role of packaging in national economy. Packaging in general economy, total packaging cost, transport cost, functional or protective packaging, effect of improvement in packaging design, substitute of resources, recycling resources - Uses of different packaging materials, packaging material cost. Relation of packaging cost and percentage lost in packaging materials - Computation of cost for different packages like CFB aluminum cans, containers etc., Bottles, Closures, Rigid Carton, Folding Carton etc.

Eco-friendly and export packaging

Importance of Eco-friendly package, Bio-Degradable Materials, Recycling of Packaging materials, 3R concept-Reduce, Reuse, Recyclable packages. Environmental aspects of packaging materials, Degradable materials for packages - Concept of solid waste. Disposal options-Green Packaging and its principles- Benefits of Eco-friendly packaging - Concept and idea of export packaging - Packaging Symbols -Considerations for export packaging - Cargo transportation, Packaging containerized cargo - Shipping documents, shipping marks - Inspection of export packaging and markings.

16. PHARMACY (DEGREE LEVEL)

i. History of Pharmacy: Code of ethics in Pharmacy, Posology; Principles of dispensing of mixtures, emulsions, powders and suppositories; Different types of Incompatibilities.

ii. Pharmacy Act; Drugs and Cosmetics Act and Rules; Drugs price control order including amendments.

iii. Methods of Sterilization and test for sterility; Preparation of vaccines, Sera and Anti-toxins; Manufacture of Penicillin and Streptomvcin.

iv. Methods of classification of crude drugs; Adulteration and evaluation of crude drugs.

v. **Introduction to secondary metabolites: Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins**

vi. Pharmacognosy of Senna, Digitalis, Ispaghula, Cinchona, Cinnamon, Rauwolfia, Podophyllum, Ergot , Cod liver oil and Gelatin.

vii. Principles, instrumentation and applications of Colorimetry, Spectrophotometry, fluorimetry, gas chromatography and High performance liquid chromatography.

viii. **Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and aminoacids.**

Principles and applications of bioassay; Types of bioassay; Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT

ix. Theory and applications of rheology (Newtonian and Non-Newtonian); Colloidal and interfacial phenomenon and their applications; Coarse dispersion (emulsions and suspensions)

x. Physico-Chemical, formulation and biological factors effecting drug absorption.

Drug discovery and clinical evaluation of new drugs- Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmaco vigilance

xi. **Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances**. **BCS classification of drugs & its significance; Application of preformulation; considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms**

Formulation, technology and qualify control of tablets, capsules, liquid orals, aerosols, creams and ointments, injectables and sustained release medicaments.

xii. **Drug stability: Reaction kinetics; Physical and chemical factors influencing the chemical degradation of pharmaceutical product, specific & general acid base catalysis, Stabilization of medicinal agents against common reactions, Accelerated stability testing, Photolytic degradation and its prevention**

xiii. **Radiopharmaceuticals: Radioactivity, Measurement of radioactivity, Properties of α, β, λ radiations, Half life, radioisotopes and study of radio isotopes-Sodium iodidel131, Storage conditions, precautions & pharmaceutical application of radioactive substances**.

xiv. Structure activity relationship, synthesis, chemical nomenclature and uses of following classes of drugs – Hypnotics and Sedatives; Tranquilizers; Analgesics and Antipyretics; Anti-inflammatory drugs; Diuretics; Anti-hypertensives and Chemotherapeutic Agents.

xv. Pharmacology of Local anaesthetics; Diuretics; Hormones; Hypoglycemic agents; Anti-histaminics; Drugs acting on central nervous system; Adrenergic and Cholinergic drugs and Cardio-vascular agents.

xvi. Pharmacokinetic and Pharmacodynamic drug interactions with suitable examples; Teratogenicity; Drug-induced diseases.

Pathophysiology of Diabetes, epilepsy, rheumatoid arthritis, leprosy, cancer, asthama, atherosclerosis.

17. PHYSICS (POST GRADUATE LEVEL)

I. Mathematical Methods of Physics

Dimensional analysis, vector algebra and vector calculus. Linear algebra, matrices, cayley-Hamilton Theorem. Eigen values and eigenvectors. Linear ordinary differential equations of first & second order, special functions (Hermite, Bessel, Laguerre and Legendre functions). Fourier series, Fourier and Laplace transforms. Elements of complex analysis, analytic functions; Taylor & Laurent series: poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem.

II. Classical Mechanics

Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Two body collisions-scattering in laboratory and centre of mass frames. Rigid body dynamics-moment of inertia tensor. Non-inertial frames and pseudo forces. Variational principle. Generalized coordinates.Lagrangian and Hamiltonian formalisms and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity-Lorentz transformations, relativistic kinematics and mass-energy equivalence.

III. Electromagnetic Theory

Electrostatics: Gauss s law and its applications, Laplace and Poisson equations, boundary value problems. Magneto statics: Biot-savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence and diffraction. Dynamics of charged particles in static and uniform electromagnetic fields. Charges particles in inhomogeneous fields.

IV. Quantum mechanics

Wave-particle duality. Schrodinger equation (time-dependent and time-independent). Eigen value problems (particle in a box, harmonic oscillator, etc..).Tunnelling through a barrier. Wave function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: Orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stem-Gerlach experiment. Time independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule.Selactin rules. Identical practices. Pauli exclusion principle.spin-statistics connection.

V. Thermodynamics and statistical Physics

Laws of thermodynamics and their significance. Thermodynamic potentials, Maxwell relations, chemical potential, Phase equilibrium. Phase space. Micro and macro- states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Bose and Fermi gases. Principle of detailed balance. Black body radiation and Planck's distribution law

VI. Electronics

Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo detectors, LEDs). Rectifiers and power supplies. Feedback amplifiers and their frequency response. Oscillators, Multivibrators. Operational amplifiers and their applications, Digital techniques and applications (Logic circuits, registers, counters and Comparators). A/D and D/A converters. Microprocessors, micro controller basics. Fundamentals of AM communication, FM communication and Fibre optic communication and their techniques.

VII. Atomic & Molecular Physics

Quantum States of an electron in an atom. Electron spin. Spectrum of Helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyper fine structure and isotopic shift, width of spectrum lines, LS &JJ couplings. Zeeman, Paschen-Bach & Stark effects. Frank-condon principle. Electronic rotational, vibrational and Raman spectra of diatomic molecules. Selection rules. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, Population inversion, rate equation. Modes of resonators and coherence length.

VIII. Condensed Matter Physics

Bravais lattice. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, Phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and Relaxation phenomena. Drude model of electrical and thermal conductivity. Hall Effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids; metals, insulators and semiconductors. Super conductivity: Type-I and type-II super conductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientation order, kinds of liquid crystalline order. Quasi crystals.

IX. Nuclear and Particle Physics

Basics of radio activity. Basic nuclear properties; size, shape and charge distribution, spin and parity. Binding energy, Semi-empirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge –independence and charge symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions. Reaction mechanism, compound nuclei and direct reactions.

18. TANNERY ENGINEERING (LEATHER TECHNOLOGY) (DEGREE LEVEL)

A. Skin Proteins and Pre-tannages

1. Chemical constituents of hides and skins – Fibrous and Non – fibrous proteins structure and Chemical Features. Reactive groups of Collagen and cross linking. Histological Characteristics of hides and skins.
2. Preservation techniques – Principles involved – short term preservation – Defect in hides and skins.
3. Chemistry and Principle of different pretanning processes like soaking, liming, deliming, bating and pickling. Different methods of pretanning processes as applied to light, heavy and industrial leathers.

B. Theory of tannages

1. Types of vegetable tanning materials – Classification, and chemistry of vegetable tanning. Mechanism of vegetable tanning. Synthetic tannins classification General methods of manufacture and application in leather processing. Chemistry and mechanism of oil and aldehyde tannages.
2. The Chemistry of Chromium salts. Preparation of Chrome tanning salts. Mechanism of Chrome tanning.
3. Chemistry and mechanism of Aluminium, Zircoium, titanium, silicate and Phosphate tannages.
4. Chemistry and mechanism of combination tannages involving vegetables tanning materials, aldehydes and other mineral tanning agents.

C. Leather auxiliaries and post tanning Operations

1) Chemistry of neutralization and bleaching processes.
2) Classification of dyes and blending of dyes. Chemistry of dyeing auxiliaries. Theory and mechanism of dyeing.
3) Principles and methods of sulfation, sulfonation and sulfitation of oils. Preparation of synthetic flat liquors. Chemistry and mechanism of fatliquoring.
4) Classification of retanning agents and their application.
5) Chemistry and methods of preparation of aqueous pigment pastes, lacquers lacquer emulsion, synthetic and protein binders and impregnating agents. Patent leather finishes.

D. Practice of Leather Manufacture – i

1) Principles and practices involved in the manufacture of following types of leathers:- E.I. tanning of kips, buffcalf, cowcalf and Goat and Sheep skins. – Vegetable tanned sole leather, Chrome sole leather. Sole leather with improved properties. – Picking band leathers and pickers. – Digressing of E.I. Leathers into different finished leathers such as semichrome glazed kid, lining leathers, ------ leathers and diaphragm leathers. – Kattai and Bunwar leathers. – Specialty leathers for mountaineering shoes, high altitude shoes and pilot gloves.
2) Role of Machinery in Leather Processing.

A. Practice of Leather Manufacture – II

1) Processes and principles involved in manufacture of following types of leather processing of Wetblue leathers – Full Chrome Upper leathers – Upholstry leather Lining leathers – Harness, belting and Saddlery leathers. – Football, Hockey ball, Cricket ball and other sports goods leathers – Chamois leather Fashion garment Leathers – Utility glove leathers.

2) Principle methods and mechanism of drying of leathers.

B. Material Testing & Quality Control

1) Principles of analytical methods employed of water, chemical agents used in soaking, liming, deliming, bating, pickling. Analysis of liquors of beam house process, vegetable tanning extracts, spent tanliquors, chrome extracts – zirconium and aluminum tanning salts. Formaldehyde oils and fats – Fatiliquor and other auxiliaries. Estimation of Epsom salt and glucose.
2) Instrumental methods of analysis using potentiometry, spectrophotometry chromatography, ion exchange resins, calorimetry.
3) Analysis of vegetable and mineral tanned leathers- Determination of PCP at azo dyes, (Aryl amine based) in leather.
4) Principles and methods employed in physical testing of leathers.
5) Standards and quality control.

C. Leather Product Technology

1) Footwear: - (a) Anatomy of human feet, foot comfort, foot care and their relationship to footwear. Foot and last measurements Shoe sizing and fitting.
   (b) Materials used of footwear – Leather and non-leather materials for upper, -- and components.
   (c) Shoe design and pattern making
   (d) Grading clicking and closing – skiving – stitching – lasting, sole attachment – bending and edge treatments.
   (e) Construction of cemented and welted shoes machines used.
2) Leather goods and garments:- Classification – selection of materials – modern methods of construction and machinery – Hand tools and grinderies, zips, linings and fittings – standardization quality control and inventory control.

D. Organisation and Management of Leather manufacture

1. Livestock population of Telangana – availability of hides and skins – marketing of hides/skins
2. Location, lay-out and selection of machinery for tanneries manufacturing different types of leathers – estimates of investment, costing and feasibility.
3. Employment generation – training and training institutes-Telangana state Leather industry Promotion Corporation(TSLIPC),Leather Parks in Telangana- labour laws for tannery occupational health and safety.
4. Export performance of Finished Leather, Leather Products – marketing strategies and development – Features of overseas sales contract – Role of financial institution.
5. Type of tannery effluents- characteristic – Different methods of effluent disposal primary and secondary systems – standards and specifications of various type of disposal – soil waste disposal.
6. Total quality management (TQM) – Basic concepts – Principles of TQM – Barriers to TQM implementation TQM – Principles – Customer Classifications – Perception of Quality – TQM Tools – Quality Systems. Need for ISO 9000, Quality Auditing, ISO 14000 concept – Requirements and benefits.Industry4.0, Leather4.0 Industry4.0 to 5.0 & Industry 5.0.

19. TEXTILE TECHNOLOGY (DEGREE LEVEL)

I. TEXTILE FIBRES

Basic terms in textiles - classification of textile Fibres –General features natural fibresfibres – Important varieties and stages in cultivation of natural fibres- Cotton, Wool and Silk. -Physical, microscopic and chemical structure of natural fibres - manufacturing of semi synthetic fibresand Synthetic fibres – raw materials and monomers used for producing synthetic polymers – requirements of fibre forming polymers - methods and techniques of Polymerisation – production processes of synthetic polymers viz. Polyster, Nylon6, Nylon6,6, Acrylic, Modacrylic – production process of staple fibres and filament yarns from the polymers- methods of texturization – identifying features, various properties and applications of textile fibres.Manufacture, properties and applications of Rubber, Spandex**,** Aramid fibres,Glass fibres, Carbon fibres**,** Metallic fibres, Vinyon**,** Flouro carbon and Micro fibres.

II. SPINNING

Methods of Ginning – different methods of yarn manufacture-influence of raw material characteristics on spinning-Blow room - principles of opening, cleaning and mixing - different machines used in blow room and their working principles – transport and control of material flow- Carding - Objectives and principle of carding-various parts of carding machine and their

functions – theory of carding action - card clothing –stop motions and auto levelling on a card-maintenance of card –card setting points–causes and remedies for carding defects and variations in sliver count – Draw frame – Objects, functions and principle of drafting - types of drafting systems – types of top roller weighting systems- drafts – break draft, main draft and total draft- Roller settings and draft distribution – Combing – preparatory processes for combing - objects and principle of combing –advantages of combing - cyclic operations of combing – factors influencing combing - noil % - Simplex - objects and basic operations on a simplex machine -parts of Simplex machine and their functions – draft on simplex - principle of twist insertion - winding mechanism - builder motion – doffing – process and product defects and remedies – Ring frame- objects and functions of Ring frame – parts and functions of ring frame – ring and traveler types and profiles – drafting arrangement and yarn guiding devices - principle of twisting and twist levels – twist and twist multiplier- structure of ring package-cop building process- ancillary equipment on ring frame-ring frame process defects and remedies – causes of yarn breakages- yarn quality and waste control- Non conventional spinning methods –open end spinning –principle of yarn formation, parts and functions of rotor sinning- principles of friction spinning – false twist spinning – air jet spinning – characteristics of yarns produced by different methods – Cone winding – parts and functions of the machine -winding parameters – post spinning processes-machines used, basic principles of doubling, reeling, singeing and conditioning - sewing thread. Classification of fancy yarns- methods of producing fancy yarns - requirements and manufacture of sewing threads -Sewing thread packages and their applications - essential properties of sewing threads.

III. WEAVING

Sequence of weaving preparatory processes – beam warping and sectional warping – pirn winding-Sizing -Importance and objects of sizing – sizing ingredients and their functions – size preparation- process parameters in size box - main parts and working of slasher sizing machine –devices and mechanisms and modern controls on slasher sizing machine – drawing in and denting in operations -basic principle of weaving - types of looms –mechanisms of a loom – shedding, picking,beat up,let off and take up–auxiliary motions on a loom – power loom accessories – loom faults - fabric defects –Automatic loom and its features, advantages, essential attachments - weft feeler mechanisms -pirn changing mechanism - bobbin loader - automatic loom winder - multiple box looms- working cycle of drop box motion-pattern chain preparation for drop box motion

Dobby shedding -Limitations of tappet shedding-Comparison of dobby shedding with Tappet shedding-Classification dobbies - Single lift and double lift dobby-Positive and Negative Dobby-working of Double lift double jack Dobby -Right hand and Left hand dobby-Position of feelers-Heald reversing motion–pegging plan for dobby **–** mechanisms of paper pattern cam dobby, Rotary dobby, Climax cross border dobby and electronic dobby - Pick finding devices for dobbies- dobby mountings.

Jacquard Shedding : types of shed formations-functional parts of Jacquard- Single lift Single cylinder Jacquard-Double lift, Single cylinder Jacquard- Double lift, Double cylinder Jacquard-parts of Jacquard harness system and their functions - Systems of Harness mounting- types of Jacquard harness Ties - Sketching the design on point paper-importance of first hook of the Jacquard- Casting out principle- steps to card cutting-preparation of pattern card on piano card cutting machine-Jacquard card lacing- methods of increasing the figuring capacity of a Jacquard-working principle of Electronic Jacquard.

Shuttle-less weaving: Yarn quality requirements for shuttle-less looms- Weft accumulator – classification of shuttleless looms, their featuresand fields of application- types of selvedges– characteristics of fabrics woven on different shuttle less looms –method of weft insertion on Sulzer projectile loom and Rapier loom - types of rapier looms - Dewas system and Gabler system -characteristics features,essential requirements of Air Jet loom- Maxbo Murata Air Jet loom -Traverse aids for maintaining air flow- weft insertionon water jet loom -types and working principlesmulti-phase weaving machines-Circular weaving -Terry loom –formation of pile by Terry motion -loom particulars for weaving terry cloth -principle of producing cut pile fabrics - characteristics of yarns used for terry fabrics-representation of basic terry pile structure -working principle and applications of narrow loom-working principle and applications of Tri axial loom.

IV. WOVEN FABRIC DESIGN

Elements of woven fabric design - method of weave representation- procedure of drawing design and constructing draft, denting plan and lifting plan- types of drafts - reed selection in weaving- Classification of weaves -methods of ornamenting fabric.Plain weave and its Derivatives **-**Design, draft and lifting plan of plain weave-characteristics of plain weave-ornamenting plain weave - classification of plain cloths - Rib weave and Matt weave designs, draft plan, lifting plan, characteristics and applications- particulars, characteristics and end uses

of standard plainwoven fabrics, approximately square plain cloth, warp faced plain cloth, Weft faced plain cloth, Voile fabrics - Twill Weaves **-** twill weaves- classification- design, draft and lifting plan, characteristicsend use products of various classified twill weaves -angle of twill and direction of twill.-factors that determine the prominence of twill weaves- designs of modified twill weaves - twist and twill interaction on appearance of fabric- Compound Weaves**-**sateen and satin weaves- design, characteristics, quality particulars and end use products of the weaves - Honey comb -Brighton honey comb -Huck – a- back, Mock leno - crepe weaves -methods of producing crepe surface-development of distorted thread effects- Classification, design, Standard quality particulars, end uses, weaving arrangement and loom equipment needed for Bedford cords, Welts and Piques -Principles of colour and weave effects**-** Extra Threaded, Backed and Double Cloths**-**methods of increasing weight of fabric -principle and different methods of producing, loom equipment needed for extra thread fabrics -different methods of disposing surplus extra threads -Backed fabrics –steps in construction of backed fabrics - Classification, principles of production and applications of double cloths.

V. CHEMICAL PROCESSING OF TEXTILES

Preparatory for wet processing: Requirements of water for chemical processing of textiles-hard water and soft water - temporary hardness and Permanent hardness - Zeolite process of removing water hardness - mechanism of wetting textile material-functions of soaps and detergents in wet processing- anionic, cationic and nonionic surface active agents-sequence of chemical preparatory treatments for the textiles made by different types of fibres- wet processing of yarns, woven fabrics and knitted fabrics- commonly used chemicals in wet processing of textiles- effect of PH in Chemical processing of textiles -sequestering agents - different methods of singeing,desizing, scouring, bleaching and Mercerising – mercerisation of woven and knitted fabric- evaluation of the chemical preparatory processes.

Dyeing: General characteristics and essential properties of dye stuffs-Classification of dyes-applicability of various dyes on different fibres and characteristics of respective dyeing--natural dyes and synthetic dyes – types of dyeing based on form of textiles-functional groups in textile fibres responsible for dyeing- forces responsible for dye fixation - dye bath interactions - role of additives in dyeing - general mechanism of dyeing- batch dyeing-continuous dyeing-general terms usedin dyeing - fibre dyeing- yarn dyeing-fabric dyeing and product dyeing- colour fastness ratings – methods and stages in application of water soluble dyes, water insoluble dyes and ingrain dyes- dyeing machinery used for fibres , yarn , fabric and garment and their working principles – methods of water extraction and drying the dyed textiles -preparation and dyeing of bast fibres -wool, silk and semi synthetics viz., Viscose and Acetate textiles – preparation and dyeing of synthetic textiles viz- polyster, Nylon, acrylic textiles with various dyes– mass colouration of textiles – dyeing of blends - dyeing of woven garments, knitted garments - dyeing of cotton garments, woollen garments, Polyester garments -fastness properties - dyeing faults.

Printing and finishing of textiles: essential ingredients used in print paste– different methods of printing – different styles of printing –after treatments for printed goods -identifying features of various methods of printing- finishing of textiles -classification of finishing treatments - principles of drying – calendaring - permanent setting of wool - heat setting of synthetics – Sanforising, anti-creasefinisih, wash and wear resistant finish, durable press ,water repellence and water proofing , Softening and stiffening, Soil release and stain release finish, Parchmentizing, Flame proofing-process sequence of garment finishing.

VI. APPAREL PRODUCTION

Sample development : Basic definitions related to Apparel manufacture- Pattern Making and developments of Garment Sample-fabric properties to be considered for makinggarments - Importance of Measurements - pattern making –paper pattern - stages for pattern making-allowances for pattern making -Methods of pattern grading – manual and computer aided methods of garment pattern making - garment pattern construction -types of samples and their uses - proto sample development - sequence of garment sampling stages.

Marker making and spreading – methods of marker making –Marker efficiency- maker planning –requirements, quality control in marker planning - requirements, procedures and methods of fabric spreading- Automatic programmable spreading machine- quality factors and common problems in spreading-fabric cutting - process sequence, requirements, types of cutting machines - advantages and disadvantages of each- common defects in fabric cutting.

Sewing: Stitching machines required for garment industry - lock stitch formation - reasons for thread break, needle break and skip stitch - safety rules for garment sewing machine operator-types of garment stitches - types of stitches for knit fabrics - types of sewing machines - seam - types of seams and their uses - Seam defects and seam quality defects - causes of seam puckering.

Garment accessories, Packing and Finishing: Classification of garment accessories - garment closures - types and functions of interlining-requirements of fusing process - methods of resin coating for fusible interlining - features, scope and working principle of continuous fusing machine-, support materials – stays, lining, interfacing, shoulder pad- Pressing-principles, methods and components of pressing - principle of pleating -information contained in labels - types of labels -meaning of international care labelling codes - packing accessories and their functions. Decorative garment accessories - Features, types and uses of Lace fabrics - types of stays -classification and functions of different trimmings -types and manufacturing process of Ribbon - Bias tape - process of direct –to- Garment printing -garment decoration techniques – Appliques, Bias trimming, Ruffles , Smocking and Faggoting.

Apparel Merchandising: Flow chart of merchandising-activities-qualities and skills of merchandiser -key players in the apparel industry -sourcing of Raw material -types of merchandisers in apparel industry -various items required for production file -Buyer inspection - tracking system for effective merchandising -basic terms of Fashion terminology -Fashion cycle in Garment industry-functions of fashion Merchandiser -steps in marketing of fashion design - qualities of successful fashion designer -variations in fashion adoption -consumer identification with fashion cycles -tasks of Retail Merchandiser -objectives of Visual Merchandising-functions of Visual Merchandiser- essential tools used for Visual Merchandising

VII. TEXTILE TESTING

Sampling methods for fibres, yarns and fabrics- Routine tests conducted in textile mills and the method and instrument used for each –Influence of moisture and measurement of moisture – standard regain of textile fibres- Conditioning of samples for testing- Measurement of fibre parameters- different methods and instruments used for measuring fibre length, fineness, maturity and fibre neps on conventional and advanced instruments –Measurement of yarn count, yarn twist, yarn hairiness, yarn evenness, yarn faults - instruments used and principles of testing- Stress – strain curves of textile fibres - different principles of tensile testing - measurement of fibre strength, yarn strength and fabric strength – instruments used, principles of testing and methods - measurement of fabric constructional particulars, dimensions and properties- Testing of fabric handle, stiffness Drape -fabric comfort properties - air permeability water repellence, thermal insulation, thermal conductivity and flammability of the fabric –testing of serviceability properties - Identifying the type of fibre in the fabric -evaluation of soil and stain removal-evaluation of fabric stretch properties-methods for testing knitted fabrics- testing of courses and wales per unit length-spirality intended for form-fitting apparel-causes of shrinkage and dimensional changes in garment-principle of evaluating dimensional changes in the fabric - durable press evaluation of the fabrics and apparels-testing of dyed fabric properties - fastness to light, washing, dry cleaning, hot pressing, chlorination, crocking, perspiration, testing for class of dye in the dyed fabric-factors influencing strength properties of apparel -factors influencing seam strength in woven fabrics and knitted fabrics-causes of yarn slippage in woven fabrics-Bow and Skewness -Yarn severance and Seam Puckering-reasons for seam puckering-causes of snagging-effect of physical properties on puckering

VIII. STATISTICAL TOOLS AND QUALITY CONTROL

Causes of variation in textiles- calculation of standard deviation, variance, coefficient of variation - control limits and specification limits- control charts-types of control charts-Control charts for averages, range, fraction defective, number of defects -control line, Upper control limit and lower control limit for each chart- chance causes and assignable causes-Process capability- Six sigma - characteristics of normal distribution curve-problems on significance testing for mean and dispersion–correlation - Methods of studying correlation- uses of correlation- calculation of Karl Pearson coefficient of correlation**-** Concept and importance of quality- definitions of basic terms related to quality-elements of quality management -divisions of cost of quality- quality costs in relation to the garment manufacturing – benefits and importance of standards-sources of standards for textiles-Quality Management Systems - ISO 9000 Standards- TQM- quality improvement program by Kaizen- 5 S quality system- quality circles- -Seven tools of quality Improvement-Flow chart, Cause and effect diagram, Pareto diagram, Check sheets, Histogram, Scatter diagram and Run charts.

IX. TEXTILE MATHEMATICS

Micronaire - yarn diameter- problems on direct and Indirect yarn count systems - conversion factors-count of folded yarn – Calculations in Cotton spinning - bale density -blows / inch of a beater - Waste % and cleaning efficiency of a beater and blow room –cleaning efficiency of a card -surface speed - drafts in various departments - creel table draft, break draft, main draft, web draft and total draft - Draft constant and change wheel –hank of delivery sliver – linear density of lap –production and production efficiencies of various machines in spinning–

Calculation of twist -twist in roving and yarn - relation between twist and count - front roller delivery - yarn realization -calculations in cone winding - time required, number of drums required to wind given weight of yarn -calculation of Yarn tension, clearer setting -clearing efficiency- Spin plan - Average count of warp -Weight of yarn on beam- beam count-Minimum mass of yarn for supply package-Time to complete a beam -Warping machine running efficiency-Proportion of warper's beam to slasher beam - width of section and number of ends in the section -Number of sections to be made -Size pick up & size add on-Weight of size required -Count of sized warp- -running efficiency of warping machine and sizing machine -Number of looms that could be fed by a slasher sizing machine – Take up and regain of warp and weft - Relation between reed count and reed width-Relation between Loom pick and picks per inch in the cloth -Average speed, average reed space, average picks-production of a loom -time required to weave given length of warp -length of warp required per loom per hour -warp and weft crimp in woven fabric- Weight of warp and weft required to produce given piece of fabric - cover factor-No of machines required for a target production - Production calculations in Garment manufacture- production target, operator efficiency, line efficiency, machine efficiency, machine productivity, Labour productivity, standard time, Labour cost per unit, fabric consumption for producing a garment and thread consumption

X. KNITTING & NONWOVEN TECHNOLOGY

Basic terms of Knitting - properties of knitted structures - weft knitting and warp knitting-functional elements used on a (weft) knitting machine -loop forming sequence of knitting needle - Basic weft knit structures–Representation of weft knit structures- characteristics of single jersey structures -Warp Knitting- principle of producing basic warp knit fabric -functional elements of Tricot and Rachel machines - knitting cycles of tricot and Raschel machine - differences between warp knits and woven fabrics -Apparel and non-apparel uses of knitted fabrics**-** Process stages in nonwoven manufacture- classification of nonwoven fabrics - methods of web formation - methods of bonding the web - principle of producing needle punched nonwovens- techniques of adhesive bonding , principle of hot calendar thermal bonding-Extrusion nonwovens- Spun bonding and spun laced techniques -Melt blown techniques - structure and general characteristics of nonwovens- applications and Scope of non-woven fabrics- Comparison between Non-Woven & Woven Fabrics

XI. TECHNICAL TEXTILES

Classification of technical Textiles - scope of textile fibres for use in technical applications - yarn manufacturing technologies of producing technical yarns - fabric structures (woven, knitted and nonwoven) used for technical applications -various finishes and coatings for fabrics for Technical applications -scope and utility of various technical textiles-applications of nonwovens in Technical Textiles- Classification of Medical textiles- product, fibre type and manufacturing system of implantable medical textile and Non-implantable medical textiles. Health care Hygiene products -fibre type and construction of suture -extra corporeal devices- requirements of fibres for medical textiles - scope and advantages of using textiles for filtration -theory, principles and process of dust collection in aerosol filtration - types fabric cleaning mechanisms- considerations in selection and design of fabric filters-Classification of geo synthetics - functions of geo textiles and their application fields - structure and uses of different types of geo synthetics - properties of Geo Textiles - advantages of Geo textiles made by Jute.Inherently flame-retardant fibres - the process of flame retardation of conventional textile fibres -water proof breathable fabrics - application of textiles for survival - physical requirements of military textiles-environmental requirements of military textiles for heat,flame and hazards- ballistic textile **-** typical military textiles-Requirements of textiles for transportation - textiles used in road transportation - application of textiles in Architecture and Construction - application of textiles in Agriculture, Sports and Recreation - requirements of sports surfaces structure and manufacturing of tyre cards - classification of textile composite reinforcement - the application of textile structural composites