ANNEXURE-II

NOTIFICATION NO.23/2018

SCHEME AND SYLLABUS FOR THE POST OF LECTURERS IN GOVERNMENT POLYTECHNICS (ENGINEERING & NON ENGINEERING) IN A.P. TECHNICAL EDUCATION SERVICE

(As per the Annexure – III to the G.O Ms. No. 141, Finance (HR-I Plg & Policy) Dept., Dt. 01/08/2016)

PART-A: Written Examination: (Objective Type)				
Paper	**Subject**	**No. Of Questions**	**Duration Minutes**	**Maximum Marks**
Paper-1	General Studies & Mental ability	150	150	150
Paper-2	Concerned Subject	150	150	300
PART-B:ORAL TEST (Interview)				50
Total				500
N.B: As per G.O.Ms. No.235 Finance (HR-1, Plg & Policy) Dept, Dt: 06/12/2016, for each wrong answer will be penalized with 1/3rd of the marks prescribed for the question in all Objective type papers.				

N.B: 1. The paper in concerned subject for Engineering streams is of Engineering Bachelor's degree standard.

2. The paper in the concerned subject for Non-Engineering streams is of P.G. Degree standard

3. The Question papers will be in English only.

1.	Architectural Engineering
2.	Automobile Engineering
3.	Bio Medical Engineering
4.	Commercial & Computer Practice
5.	Ceramic Technology
6.	Chemical Engineering
7.	Chemistry
8.	Civil Engineering
9.	Computer Engineering
10.	Electronics & Communication Engineering
11.	Electrical & Electronics Engineering
12.	Electronics and Instrumentation Engineering
13.	English
14.	Garment Technology
15.	Geology
16.	Marine Engineering
17.	Mathematics
18.	Mechanical Engineering

19.	Metallurgical Engineering
20.	Mining Engineering
21.	Pharmacy
22.	Physics
23.	Textile Technology

PAPER-I: GENERAL STUDIES AND MENTAL ABILITY

1. Events of national and international importance.
2. Current affairs- international, national and regional.
3. General Science and it applications to the day to day life Contemporary developments in Science & Technology and information Technology.
4. Social- economic and political history of modern India with emphasis on Andhra Pradesh.
5. Indian polity and governance: constitutional issues, public policy, reforms and e-governance initiatives with specific reference to Andhra Pradesh.
6. Economic development in India since independence with emphasis on Andhra Pradesh.
7. Physical geography of Indian sub-continent and Andhra Pradesh.
8. Disaster management: vulnerability profile, prevention and mitigation strategies,
   Application of Remote Sensing and GIS in the assessment of Disaster.
9. Sustainable Development and Environmental Protection
10. Logical reasoning, analytical ability and data interpretation.
11. Data Analysis:
    a) Tabulation of data
    b) Visual representation of data
    c) Basic data analysis (Summary Statistics such as mean, median, mode, variance and coefficient of variation) and Interpretation
12. Bifurcation of Andhra Pradesh and its Administrative, Economic, Social, Cultural, Political, and Legal implications/problems.

PAPER-II

1. ARCHITECTURAL ENGINEERING

Engineering Mechanics: Free body diagrams, Equilibrium equations, Analysis of determinate trusses, Simple stress and strain, Types of stresses, Principal stress and Mohr circle of stress, 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.

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

03. Building materials : Clay Bricks, Stones, Sand, Mortars, Cement, Cement mortar, Concrete, Reinforced cement concrete, Timber, Veneers, Paints and Varnishes, Glass, Rubber, Adhesives, Asphalt and Bitumen, Plastics, roofing and flooring materials, metals, ally steels, non-ferrous metals, stones- classification, properties, aggregates — coarse and fine aggregates, Admixtures.

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

05. Architectural Drawing and Graphics: Importance of Scale, Different forms, Architectural representation of different objects, Solid geometry, Building Geometry —isometric. Rendering, visualization skills and importance of free hand drawing.

06. 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.

07. **History of Architecture:** Architectural development in Egypt, Greek, Roman, Early Christian, Romanesque, Gothic & Byzantine. Indian Architecture. characteristic styles of modem architecture, Arts and Crafts movement, Art Nouvean, Monumentalism, Expressionism. Surveying and Site Studies: Principles of Surveying, Computation of areas and levelling, Theodolite surveying, Total station and GPS.

08. **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, BOD, COD, Principles of drainage.

09. **Climatology:** Building Climatology, Tropical Climates, Thermal Comfort, Heat flow, Natural ventilation, passive cooling, Sun & Design Process.

10. **Landscape design and site planning:** Importance and role of landscape designing, Historical perspective, Elements in Landscape design, Plants and design, Landscape construction.

11. **Building Services:** Electrical services, Lighting, Air Conditioning, Elevators and Escalators, Telephones and EPABX, Security systems, Firefighting systems, Swimming pools, And Energy sources of building: wind energy, photo voltaic, bio mass, Waste disposal: Industries and hospitals, Hotel services and elevated flooring.

12. **Sociology of human settlements:** sociological aspects, Elements of society, Urbanization, Historic evolution, Transportation and communication, Principle of ekistics.

13. **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.

14. **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, FSI planning of industrial and recreational areas, urban renewals. TCPO and Town planning organization in India.

15. **Building Acoustics:** Need to study acoustics, history of acoustics, generation, and 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.

16. **Advances construction:** Decay and Damage, Building Failures, Maintenance and Renovation, guniting, Strutting. Underpinning, Grouting, Propping, Effect of ageing, Weathering.

17. **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 ode, Consumer protection act. Transfer of property.

18. **Computer applications:** hardware and Software requirements, Operating systems, Features of presentation package, drafting packages and benefits of internet technology.

2. AUTOMOBILE ENGINEERING

1. Thermodynamics: systems – Zeroth Law of thermodynamics – First law of thermodynamics – Second Law of thermodynamics – Entropy – Statistical thermodynamics – Air Compressors I.C. Engines cycles and Process – Combustion in I.C. Engines – Engine performance – Scavenging and supercharging of Engines – Modern development in I.C. Engines – I.C. Engine plant layout.

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

3. Fluid Mechanics and Machinery: Fluid properties – Dimensional analysis – Fluid static's Flow past immersed bodies – Centrifugal pumps – Axial flow pumps – Rotary pumps – Reciprocating pumps – Oil Hydraulic systems.

4. Instrumentation: Transducers – Flow measuring transducers – Temperature measurement – Strain gauges – Mechanical measuring devices – Slip gauges – Plug gauge – Micrometers in bars optical flat etc.

5. Automobile chasis & Systems: Chasis layout – Shock absorbers in dependent suspension – torsion bars – gear suspension – wheel balancing – tyres and tubes – constructional details of the engine – Ignition system – Fuel system – Lubrication system – Cooling system – Transmission system – Brakes steering mechanism – Electrical circuits and equipment's – Engine troubles – Air conditioning system – Modern trends in automobiles & Engines.

6. Material Science: Crystallography of metals – Binary alloys – Constitution and equilibrium diagram – methods of studying metal structure – Heat treatment – of steels – Casehardening and surface treatment of steels – Non Ferrous metals and alloys – Creep – Fatigue.

7. Kinematics of Machines: Kinematics – Velocity and Acceleration – Properties of instaneous centre – Gears – Gears trains – Oams – Governors – Brakes and dynamometers – Clutches – Power transmission – Chain drives.

8. 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.

9. Design of Automobile Machine Parts: Design of welded joints Design of bolts & nuts Shafts and Axles – Curved beams – Springs – Bearings – clutches – Brakes – Design of connecting rod – Crank shaft fly wheel.

10. Production Technology: Machine tools – Lathes – Shaper, planner and slotting machines Drilling and boring machine – Milling – Lapping – Tool room – Electro machining – Welding – Brazing – Foundry.

11. Industrial Engineering: Industrial management – personnel function – Production facilities – Production Planning and control – Wages and incentives Cost Control – Marketing and Sales Promotion.

3. BIOMEDICAL ENGINEERING

Physiology

Cell biology and biopotentials, leuromuscular physiology, espiratory system, Cardiovascular physiology, Renal physiology, Gastrointestinal and endocrine physiology) Auditory system and Vision

Clinical Immersion

Cell biology: 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 I PSP.

Electrical Activity of the heart. Conduction system of the heart. Characterstics of Action potentials at SA mode, Tria, 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 extermity 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. Survace 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 schematicdiagram of the ear. Mechanical transformer of the middle ear. Frequency analysios of sound by the basilar membrane. Cochelear 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.

Bio-Medical Instrumentation.

General Characteristics . of medical instrumentation like linearity, range, frequency response, signal-to-noise ratio and stability. Equivalent circuit Properties.

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. Visualising 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 equipments. Development of instrumentation for Clinical practice and Medical Research, Introduction. Comparative study of industrial and Medical Instrumentation.

Electrical Safety and Standards:

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 safe patient - electrical environment.

Sensors and transducers for Biomedical applications:

Transducers for physiological application. Stratic-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.

Amplifiers for Biomedical applications:

Operational amplifiers, Differential, Instrumentation amplifier, Carrier amplifiers, Phase sensitive detector for LVDT. Principles of wave generation and shaping.

Recorders and play divices for Bio-Medical applications. General features of ink-jet, thermosensitive and optical recorders. General features of display devices for bio-signals. 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. 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.

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

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

Biosensors: Electrochemical biosensors, impedometric, voltammetry, amperometry, mechanical transducers, MEMS-based

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

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

Hearing Aids: Different Types, Comparision of Microphones, Receivers and Amplifiers, cochlear implants

Biophotonics, Introduction to the principles of optics, lasers and biology, the interaction of light with cells and tissues, and various optical imaging, sensing and activation techniques and their applications in biomedicine.

Lasers: Basic Principles of Laser, Different types of Laser Equipment used in Ablations, Surgery. Laser Safety prinCiples and classifications.

Fibre Optics: Principles and Applications : Endoscopes, Neonatural insturmentation, Incubators, Apnea Monitor, Opthalmic Instrumentation : Intra - ocular Pressure Measurement, Contacting and Non-contacting Types, Refractometers.

Optical microscopy, phase contrast microscope, Differential

interference contrast microscope, Confocal and multiphoton microscopy, Fluorescence microscopy.

Diffuse Optical tomography and Optical coherence tomography

Optical sensors, Fiber optics sensors, Surface plasmon resonance-based biosensing

Methods of Chemical analysis: Absorption photometry: Emission photometry; Fluorometry, Introduction to autoanalyzer. Chromatography for blood gas analysis, Colorimeters., Spectrophotometers, Electrophoresis.

Biomedical Imaging

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

Sonography, basic principles, ultrasound-based imaging, Ultrasound Applications for Surgery: Lithotripsy, Principles and Applications. 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 Dopler flow meter. Display Devices for Ultrasonic Echo Imaging. Biological Effects of Ultrasound and Safety Precautions.

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

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

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

Radio Nuclide Imaging: Principle, Schematic functional diagram and Components of Gamma Camera. Medical Applications, safety and precautions.

Position emission tomography (PET) and Single Photon Emission Computed Tomography (SPECT): Basic Principles, Nuclear Reactions and production of precursors. Detector Materials reconstruction techniques.

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

Biomedical Devices

Defibrillators : D.C. Defibrillators of capacitive discharge and delay line capactive discharge with basic circuit diagrams. Types of electrodes and their features. 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 Heat : Principles of external counter-pulsation techniques. Infra-
aortic Balloon pump. Auxilliary ventricle and schematic for temporary by-pass of left ventricle.

Prosthetic Heart Valves: Qualitative requirements. Categories Mechanical and tissue valves. Types of mechanical Valves - ball and cage, tilting disc and bileaflet valves. Types of tissue valves - Homografts 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.

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

Intensive Coronary Care Concepts: Systems organisation, Critical Physiological parameters to be monitored. Layout and safety precautions.

Physical Therapy Equipment. Short wave, Microwave and Ultrasonic

diathermy.

4. COMMERCIAL AND COMPUTER PRACTICE

1. **Financial Management:** Meaning, nature, objectives and scope of financial management. Capital budgeting, process, techniques. Sources of finance. Cost of capital - cost of various sources of finances. Leverages - operating and financial leverages. Capital structure theories. Working capital management - cash, receivables and inventory management.

2. **Financial and management accounting:** Techniques of analysis of financial statements - comparative and common size statements, trend analysis and ratio analysis. Funds flow and cash flow analyses.

3. **Managerial Economics:** Meaning, nature and scope of managerial economics. Demand analysis. Production and cost analysis. Market structure - perfect and imperfect markets.

4. **Business environment:** Meaning and components of business environment. Industrial policies, and 1991. Liberalization, privatization and globalization. WTO.

5. **Marketing management:** Meaning, concepts, nature and scope of marketing management - marketing environment. Consumer behavior and market segmentation. Product, price, promotion and Channel management.

6. **Quantitative techniques:** Sampling and sampling methods. Probability and probability distributions - hypothesis testing. Parametric tests (Z, t-tests and ANOVA) and non-parametric tests (Chi-square tests).

7. **Business Mathematics:** Simple and Compound Interest, Calculating value of annuities, Functions and graphs, Limits and differentiation, Basic Matrix operations, Basics of Linear Programming.

8. **Computer tools for office applications:** Basic knowledge of computers and its peripheral equipment, Use of word processing (such as MS Word) and spreadsheet management (such as MS Excel) software. Use of internet and email for office correspondence. Use of accounting packages (such as Tally).

5.CERAMIC TECHNOLOGY

FUELS, FURNACES & PYROMETRY:

A. FUELS:

1. **Solid Fuels:** COAL: Coal formation theories, Mineral matter, Classification, handling and storage, washing, general properties, Calorific value, grind ability etc.

2. **Gaseous Fuels:** Various gaseous fuels like Producer gas, Water gas, Coke Oven gas, other gaseous fuels like blast furnace gas, LPG, CNG, Natural gas – Properties like composition, calorific value.

3. **Liquid Fuels:** Petroleum products – Origin, composition, refining process, distillation of petroleum products – brief outlines. Synthetic fuels, storage and handling – general industrial practices.

4. **Properties:** Analysis of coal, gaseous fuels, liquid fuels.

B. FURNACES:

1. **Combustion:** Combustion calculations, liberated heat, available heat, waste gas – Solid, Liquid and Gaseous fuels – Pulverisation of fuel, atomization of fuel, propagation of gaseous mixture, diffusion of flame, control of combustion.

2. **Heat Transfer:** Heat transfer to charge by conduction, convection and radiation, flow of heat through furnace walls, heat losses, heat balancing, heat recovery – recuperators and regenerators.

3. **Types of furnaces:** Various types of furnaces and kilns used in ceramic industries

C. PYROMETRY:

Measurement of temperature – temperature scales – thermometers – pyrometric cones thermoelectric current – thermo couples – resistance pyrometers – radiation pyrometers – optical pyrometer.

CERAMIC SCIENCE

CRYSTAL CHEMISTRY: Ionic bond with examples – Potential energy curve-bond strength Lattice energy – Covalent Bond – Atomic and molecular orbitals, hybridization – Metallic bond Vanderwall's bond – Hydrogen bond, Mixed bond. Relation to bond vis-à-vis melting point, hardness, electrical and thermal properties – Crystalline defects; Point defects, line defects.

1. **PHASE EQUALIBRIA AND PHASE DIAGRAMS:** Gibb's rule and its interpretation; condensed system – One component system – Binary diagrams – Lever rule – Familiarity with SiO_2 – Na_2O, CaO – Al_2O_3, SiO_2 – Al_2O_3 – Ternary phase diagrams - Na_2O, CaO - SiO_2, CaO - Al_2O_3 - SiO_2, MgO – CaO – SiO_2.

2. **MECHANICAL PROPERTIES:** Elastic properties – Stress & Strain – tensile, compressive and shear stress strain, elastic moduli – Poisson's ratio – PLASTIC DEFORMATION – Simple oxides – dislocation and slip, creep, effect of temperature, Polyphase materials – influence of microstructure – BOTTLE FRACTURE – Fracture energy – Flaws and their origin and role. Hardness & Abrasion – Relationship with other properties, elastic modulus, creep – Abrasives

3. **THERMAL PROPERTIES:** Specific heat – Latent heat of fusion – Fusion point – Melting point. Thermal expansion – Simple ionic crystals – Class – Polycrystalline materials. Thermal conductivity – Theory – Simple oxides – Polycrystalline materials – Thermal stress – Permanent and temporary stress – Spalling of ceramics – Stress at interfaces.

4. **OPTICAL PROPERTIES:** Reflection and refraction – Scattering and opacity, absorption and radiation – Ionic colour in vitreous systems – Colloidal colours – Carbon – Sulphur

5. **CHEMICAL PROPERTIES:** Surface chemistry of vitreous materials – attack of water, alkalies and acids, electrode glasses, durability of glazes and enamels.
6. **ELECTRICAL AND MAGNETIC PROPERTIES:** Ionic conduction – Electronic conduction – Dielectric constant – Dielectric loss, dielectric strength, ferroelectric phenomena. Para- magnetism and ferromagnetism in ceramics.

GLASS TECHNOLOGY

INTRODUCTION: Glass industry in India – common uses – import and export of glass, present and future status.

PREPARATION OF GLASS BATCH: Glass composition – melting and fabrication, characteristics, properties and cost; composition range.

MAJOR INGREDIENTS: Sand, Limestone, Dolomite, Soda ash, Feldspar, Nephelene syenate etc.

MINOR INGREDIENTS: Melting accelerators, Refining agents, docolourisers.

CULLET: Cullet and its use- BATCH calculations

GLASS MELTING PROCESS: Particle size, melting, volatilization, refining – sources of gas bubbles – fused batch interface and re-boil, identification of gases, refining agents, chemistry of refining actions – Homogenisation – rate of homogenization – viscosity glass at various stages, standard viscosity points, working characteristics, viscosity – temperature relationships of common glasses.

FABRICATION PROCESSES: Conditions of glass; feeding; blowing and pressing – effect of variations in composition on the working characteristics

ANNEALING & TEMPERING: Release of stress, annealing constant, determination of annealing schedules for slabs, continuous plate containers, tempering.

TESTING & QUALITY CONTROL: Raw materials; Sieve analysis; purity, batch analysis, density, composition and homogeneity, SQS chart, softening point and thermal expansion. Defects in Glass; seeds and blisters, cords, striae, strain and stones, methods of testing, sources of trouble and their elimination. Fabrication defects; various defects of fabrication. Testing of container; weight and capacity, flat glass.

LAY OUT OF A MODERN GLASS PLANT: Flow diagram – Site selection – storage of raw materials – batch house – melting furnace – infrastructure facilities.
BATCH PREPARATION: Handling, mixing and charging of raw materials.
GLASS MELTING TANK FURNACES: Types of tank furnaces – general features – combustion – temperature distribution – heat transfer and covection currents – heat recovery and insulation, heat balance, thermal performance. DESIGN, CONSTRUCTION & OPERATION of glass tank furnace – Electric melting.

POT MELTING PRACTICE: Types of glasses suitable for pot melting, ports and pot furnaces.

FORMING PROCESSES: Hand operations, fore hearth and feeder, machine for blown ware, press machines, moulds, parison and blow moulds. Paste moulds. Rolling of glass – drawing of sheet glass – annealing Lehr – special processes surface coating – other operations – table working.

SPECIAL GLASSES: Heat resistant glasses – Fiber glass – Glass ceramic – Optical glasses – Glasses for electrical and electronic industries.

ENAMELS

Introduction: Enamels & ceramic coatings – metal bases – pre-treatment of metal and non- metal surfaces – de-enamelling – aluminum alloys – Enamel glass composition – batch calculations – typical examples of compositions for various steels – frit making – smelting – quenching – drying – smelting furnaces – milling and mill additions. Application and Firing; Control of slips – drying & brushing, firing – enamelling furnaces – special firing methods, properties and tests. Defects and remedies of enamelling.

W HITE WARE AND HEAVY CLAYWARE

RAW MATERIAL PREPARATION: Particle size reduction – methods – comparison – analysis Mixing methods – blunger – pug mill – u mixer, Muller mixer etc – Forming methods – Slip casting - rheology of slip – plastic forming – power pressing – special forming methods.
DRYING: External parameters – critical moisture content – drying rates – driers – types – shrinkage - defects

CHANGES DURING FIRING: Thermal decomposition – changes in ceramic body – sintering – microstructure
EQUIPMENT & MACHINERY: Crushers – grinders – mixers, separators, shaper, presses (mechanical, hydraulic, isostatic) – die materials and design – driers - glazing machines – ancillary equipment.

FURNACES/KILNS: Down draft kiln – updraft kiln – coal or oil fired – flues – chimney & stack calculations, complete operations.
Tunnel kilns – oil, gas or electric fired – construction – operation – heat balancing Roller Kilns – design – function – cycles – maintenance
Others: burners – blowers etc.

FIRING PRACTICE: Furnace loading – lighting – firing schedule – temperature control – seger cones – firing defects – warpage – Microstructure – changes in microstructure in relation to sintering, typical ceramic microstructures and their control

PLANT DESIGN: Location – assessment – economics – factory layout – flow sheet – project report.

R E F R A C T O R I E S

CLASSIFICATION: Classification of Refractories – Acid - Basic – Neutral – Special Refractories

APPLICATIONS: Industries of Iron & Steel – Gas plants – Powerhouses – Non-Ferrous metals Ceramic – Cement & Fertilisers.

REFRACTORY INDUSTRY: Status and scope of Indian Refractory industry – Lay out of modern Refractory plant.

ALUMINO-SILICATES: Raw materials – Manufacturing process – Microstructure & properties Uses.

SILICA REFRACTORIES: Manufaturing process – raw materials & composition – microstructure – properties and uses.

BASIC REFRACTORIES: Magnesite – Dolomite – Chrome – combination Refractories – manufacturing process – Microstructure – Properties and uses.

SPECIAL REFRACTORIES: Alumina – Raw materials – Manufacture – Properties & uses. Fusion cast Refractories – others like zircon, carbon, silicon carbide – Spinel and refractory cements – castables – ramming masses.

C E M E N T T E C H N O L O G Y

CEMENT INDUSTRY: Indian and A.P. scenario – Large – medium – small scale units.

TYPES: Varieties of cements – occurrence – uses – manufacturing procedures.

PORTLAND CEMENT: Manufacturing methods – Wet process – advantages and disadvantages; Dry process – advantages and disadvantages. Rotary Kiln – construction – operation – Refractories used – various chemical phases present in cement. Properties of cement – testing methods.

SPECIAL CEMENTS: Rapid setting cement, Pozzolona, Slag cement etc.

SPECIAL CERAMIC MATERIALS

HIGH TEMPERATURE CERAMIC-OXIDES: Beryllia – Magnesia – Alumina – Zirconia – NON-OXIDES – Silicon Nitride – Boron nitride – Silicon carbide – Boron Carbide – Methods of production – Properties – Thermal – Electrical – Thermo mechanical behaviour.

ELECTRICAL & ELECTRONIC CERAMICS: Dielectric Ceramics – High Voltage – low frequency applications – porcelain insulators manufacture – Low voltage High frequency applications – insulators – steatite, Magnesium titanate, Cordierite, Fosterite. FERRO ELECTRIC CERAMICS – Barium Titanate – Lead Zirconium Titanates etc., - MAGNETIC CERAMICS – Soft Ferrites – hard ferrites – Magnetite – Nickel Zinc ferrites, Yttrim Iron garnet, Hexaferrites of Barium, Lead and Strontium - CERAMIC

SEMI CONDUCTORS: Germanium – Silicon – Gallium – Antimonide – Silicon carbide etc.

CERAMIC COMPOSITES: Types – Fibres and Whiskers – Fibre reinforced composites – cermets – Metal castings – Transformation toughened ceramics – Cutting Tools – Wear resistant ceramics – Grinding media, Ceramic engine parts.

NUCLEAR CERAMICS: Methods of production and properties – Uranium Oxide; Uranium carbide, Thorium Oxide; Beryllium Oxide etc.

6. CHEMICAL ENGINEERING

PROCESS CALCULATIONS AND THERMODYNAMICS: Laws of conservation of mass and energy; use of tie components; recycle, bypass and purge calculations; degree of freedom. Zeroth law; Isothermal states, Principles of thermometry. Scales of temperature. First and second laws of thermodynamics, Equations of state and thermodynamics properties of real systems;.Phase equilibria; excess properties and correlations of active components; chemical reaction equilibria. Basics statistical thermodynamics.

FLUID MECHANICS AND MECHANICAL OPERATIONS: Fluid statics, Properties of fluids: viscosity, density, surface tension, etc., Newtonian and non-Newtonian Fluids, macroscopic energy balance, Bernoulli equation, dimensional analysis, Navier-Stokes and continuity equations, flow through pipelines, flow meters, pump and compressors, elementary boundary layer theory.
Size reduction and size separation, free and hindered settling, centrifuges and cyclones, filtration, agitation and mixing, packed and fluidized beds, storage and handling of solids.

HEAT TRANSFER: Conduction, convection and radiation, heat transfer coefficients, steady and unsteady heat conduction, boiling, condensation and evaporation, types of heat exchangers and evaporators and their design principles.

MASS TRANSFER: Classification of Mass Transfer Operations (Direct contact of immiscible phases, Membrane separation of phases, Direct & Indirect Operations), Diffusion & Mass Transfer, Fick's law, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfers analogies; Gas-Liquid Operations (Bubble Columns, Multistage tray towers), Liquid-Liquid Operations, Solid-Liquid Operations.

CHEMICAL REACTION ENGINEERING: Rate of reaction, molecularity, Transition state theory; Concepts in Chemical Kinetics; kinetic of homogeneous reactions; Analysis of Rate Data, Differential and integral methods of kinetic analysis; Single and multiple reactions in ideal reactors; Non-isothermal reactors; Non-ideal flow: F & E curves, axial dispersion; kinetics of heterogeneous catalytic reactions, diffusion effects in catalysis.

INSTRUMENTATION AND PROCESS CONTROL: Measurement of process variables; dynamics of simple systems: CSTRS, heat exchangers, transfer functions, response of systems, process reaction curve, controller modes (P, PI and PID); control valves; analysis of closed loop systems including stability, frequency response (including Bode plots) and controller tuning.

PLANT DESIGN AND ECONOMICS: Design of chemical process plants, principles of process economics and cost estimation.

CHEMICAL TECHNOLOGY: Overview of Chemical Process Technology. Preparation of process flow diagrams, Instrumentation diagrams and Process symbols. Petrochemical Industries: production of petrochemical feedstocks, olefins and aromatics, intermediates from olefins and aromatics. Inorganic Chemical Industries: chlor-alkali industries, manufacture of acids, ammonia, and fertilizers. Fermentation: manufacture of sugar, starch, and its derivatives, manufacture of industrial alcohols. Edible oils: extraction and refining, fat splitting, soaps and detergents.

7. CHEMISTRY

Inorganic Chemistry:

1. Chemical periodicity: Periodic properties
2. Atomic structure, nuclear properties, molecular symmetry, bonding in polyatomic molecules, concepts of acids and bases
3. Main group elements and their compounds: Synthesis, bonding and structure.
4. Transition metal Chemistry and coordination compounds: Structure and bonding, Molecular Orbital (MO) theory of complexes, Crystal field theory (CFT), Jahn-Teller effect, magnetic properties, orbital splitting, spin-orbit coupling, calculation of CFSE, spectra of octahedral and tetrahedral complexes of dl to d9 systems, and reaction mechanisms
5. Organometallic compounds, their synthesis, bonding and structure, and reactivity. Organometallic compounds in homogenous catalysis.
6. Cage like structures and metal clusters
7. Analytical Chemistry: separation techniques, spectroscopic electro- and thermo-analytical methods.
8. Bioinorganic Chemistry — photosystems, porphyrins, metallo-enzymes, oxygen reactions, electron transfer, nitrogen fixation.
9. Characterization of inorganic compounds by infrared-, Raman- NMR-, electron spin resonance (EPR)-, UV-Visible, and Mass spectroscopic techniques
10. Nuclear chemistry — nuclear reactions, fission and fusion and their applications, radio-analytical techniques and activation analysis.

Physical Chemistry:

11. Quantum mechanics: Fundamental concepts and applications, hydrogen atom, and angular momentum
12. Atomic structure and hydrogen atom spectra, chemical bonding
13. Group theory: Basic principles and applications
14. Kinetic theory of gases: Equations of state and collision theory
15. Chemical Kinetics: order and molecularity of reactions, Arrhenius
16. equation, Activated complex theory of bimolecular gaseous reactions and Lindemann theory of unimolecular gaseous reactions, experimental methods for studying reaction rates.
17. Chemical Thermodynamics: First Law, Joule-Thomson effect, Thermochemistry, Second law, Entropy, Maxwell relations, Van't Hoff equation
18. Electrochemistry: Electrochemical cells and cell reactions, Standard electrode potentials, Nernst equation, specific, equivalent and molar conductivities, Kohlrausch's law; Concentration cells, Debye-Huckel theory and Debye-Huckel-Onsager equation, transport number and ionic mobility, potentiometric and conductometric titrations, electrical double layer.
19. Photochemistry: Laws of photochemistry, Grothus-Draper Law, Stark-Einstein law, kinetics of photochemical reactions
20. Statistical Thermodynamics: Types of statistics, partition functions, thermodynamic properties of monoatom c ideal gases, Einstein theory of heat capacities
20. Surface Chemistry: Adsorptio6 isotherms. and BET theory of multilayer adsorption

21. Catalysis: Acid-base catalysis, enzyme catalysis, Michaelis-Menten equation, heterogeneous catalysis.

22. Molecular spectroscopy: Principles and applications of rotational and vibrational spectroscopy, NMR and EPR.

23. Chemical equilibrium: basic concepts, Solubility product, common ion effect, pH and buffer solutions, acids and bases, hydrolysis of salts, phase equilibrium.

24. Solid state: crystal systems, classification of binary and ternary compounds, diffraction techniques, bonding.

Organic Chemistry:

25. Heterocylic compounds- classification based on the nature of hetero-atom, size of the ring and electron deficient nature of the ring.

26. General and comparative study of furan-, pyrrole- and thiophene- ring transformations. Comparison with benzenoid compounds: pyridine, quinoline, isoquinoline and acridine.

27. Aromaticity of cyclic compounds: synthesis, reactivity and properties.

28. Organic reaction mechanisms: Structure and reactivity of organic molecules-inductive effect, mesomeric (resonance) effect and hyper-conjugation, dipole moments, acidic and basic strengths of organic compounds.

29. Concepts of organic reaction mechanisms: Aromatic substitutions: Electrophilic and Nucleophilic substitutions (S_N1, SN2, SNi, S_N2'), Elimination (El and E2), Cope- and Hofmann- eliminations.

30. Study of reaction intermediates: classical and non-classical carbocations-, carbanions-, carbon free radical- and carbene- in organic reactions.

31. Rearrangements: Dienone-Phenol-, Baeyer-Villiger-, Favorskii-, Beckmann-, Perkin-, Fries-, Pinacol-pinacolone- rearrangements.

32. Name reactions: Wurtz-, Friedel-Crafts-, Gattermann-, Diels-Alder-, Reformatsky-, Rosenmund- reactions.
33. Organometallic reagents and their application to organic reactions: RMgX, RLi, RZnX, R2CuLi

34. Transition metal catalysis: Heck-, Stille-, Sonogashira-, Suzuki-, Buchwald-Hartwig- coupling reactions.

35. Carbohydrates: General reactions of monosaccharides — configurational studies on glucose, fructose, sucrose, and recent advances in the Chemistry of cellulose and starch.

36. Proteins: Introduction to proteins, their classification, nomenclature and distribution in nature, simple amino acids — their isolation and their synthesis.

37. Alicyclic compounds: Mono-terpenes

38. Stereochemistry: Optical and geometric isomerism, configuration of saturated molecules, dextro and laevo, and R- and S- configurations of optically active compounds, racemic mixtures, racemization and resolution.

39. Characterization of organic compounds by infrared (IR)-, NMR-, UV-Visible-, and Mass- spectroscopy techniques.

8. Civil Engineering

1. ANALYSIS OF STRUCTURES:

Stresses in beams; combined bending and direct stresses; axially and eccentrically loaded columns
Closed-coiled and open-coiled; helical springs under axial load and axial twist; carriage springs
Analysis of thin and thick cylinders; compound cylinders
Analysis of statically determinate plane trusses; method of joints and method of sections
Deflection and slope of beams by Double integration Macaulay''s, Moment area and Conjugate beam methods
Analysis of statically indeterminate beams by flexibility and stiffness methods; propped cantilevers, fixed beams and continuous beams
Strain energy method, slope-deflection method, moment distribution method and Kaini's method of analysis of indeterminate structures.
Struts subjected to axial loads, buckling, Euler's formula for strut with different support conditions

2. STRUCTURAL DESIGN:

Reinforced concrete, concrete technology, R.C.C. Design, working stress method and limit state method, Design of beams, design of axially loaded columns, Design of one-way and two-way slabs, design of continuous beams and slabs; Design of wall footings and isolated footings, combined footings, raft foundations, and retaining walls by limit state method, water tanks, Deck-slab and T-beam bridges by working stress method. Structural Steel — design of riveted and welded joints, design of tension members; Design of compression members; simple and compound beams. Design of plate girders, crane girders and roof-trusses. Elements of pre-stressed concrete.

3. FLUID MECHANICS AND HYDRAULIC MACHINES:

Fluid properties; fluid statics; fluid-flow concepts; Laminar and turbulent flow; steady and unsteady-flow, uniform and non-uniform flow; continuity equation; Euler's equation of motion; Bernoulli's equation, Hydrostatic force on plane and curved surface
Momentum equation and applications; Moment of Momentum equation, Dimensional analysis and similitude; Flow through Pipes: Viscous flow-laminar flow through circular pipes; velocity distribution in laminar flow. Turbulent flow in pipes, velocity distribution in turbulent flow
Flow Measuring Devices- Measurement of discharge, venturimeter, orifice meter, notches and weirs, Measurement of velocity, Pitot tube
Hydraulic machines; Turbines and pumps; basic equations; performance selection, specific speed

4. WATER RESOURCES ENGINEERING:

Steady flow through open channels. Uniform flow in channels; Chezy's and Manning's formulae. Specific energy and critical depth. Hydraulic jump — Momentum equation for a hydraulic jump. Surface Water hydrology; Hydrologic cycle, hydrologic data- measurement of precipitation, evaporation, transpiration, and infiltration. Runoff, determination of run-off. Steam gauging; Hydrograph *and* unit hydrograph, flood routing. Ground water resources, Darcy's law, Dupuits equation, yield of wells, recuperation test.

5. SURVEYING:

Chain surveying; compass surveying, plane table surveying; leveling and contouring, Minor instruments; Areas and Volumes; Theodolite surveying and traversing; Tachometry; Curve ranging; setting out works.
Principles and uses of triangulation, hydrographic surveying, Arial photogrammetry and photo interpretation, remote sensing and electromagnetic distance measurement.

6. GEOTECHNICAL ENGINEERING:

Physical properties of soils; identification and classification of soils; soil compaction; permeability and seepage; stress distribution in soil; consolidation; shear strength of soil; stability of earth slopes; site investigation and sub soil exploration; lateral earth pressure and retaining walls; bearing capacity and shallow foundations; pile foundations; well foundations; Machine foundations.

7. TRANSPORTATION ENGINEERING:

Highway Engineering; classification of roads; highway alignment and surveys; geometric design of highways; elements of traffic engineering; highway materials and testing; elements of pavement design; construction and maintenance of earth gravel, W.B.M., bituminous and concrete roads; highway drainage

Railway Engineering; engineering surveys for a new railway route, gauge and gauge problem; track components; ballast; sleepers; rail fastenings; Station and station yards; requirements and requirement for station yards; signaling and inter locking. Elements of cross drainage works; causeways; culverts; bridges

8. ENVIRONMENTAL ENGINEERING:

Water supply engineering; source of water supply, conveyance of water, distribution system; quality of water; treatment of water; filtration; disinfection; method of water treatment

Air pollutants – monitoring, quantification and standards

Charateristeristics of sewage: composition; B.O.D., C.O.D., aerobic and anaerobic decomposition; chemistry of sanitary sewage; sewage disposal; primary and secondary treatment of sewage; design of sewers

9. COMPUTER ENGINEERING

1. Hardware: Logic families, gates, flip-flops, Multiplexers, decoders, registers, counters, adder circuits, Boolean algebra, Combinational circuit design, minimization, sequential circuit design, number systems, inter conversion, number representation, computer organization, instruction formats, addressing modes, micro-programming, ALU organization, multiplication and division algorithms, memory hierarchy, cache and associate memories, virtual memory, memory IC's, I/O organization schemes, interrupts, arbitration, DMA, microprocessors, interfacing, pipeline, SIMD and MIMD organizations

2. Discrete Mathematics: Proposition and predicate logics, methods of deduction, set theory, relations, functions, algebraic structures, lattices, recursion, combinatorics, Graph theory: representation, Shortest paths, Warshall's algorithm, cyclic and bipartite graphs, Hamiltonian graph, chromatic number, trees, binary tree traversals, representation of expressions, breadth-first and depth-first algorithms, spanning trees, Prim's and Kruskal's algorithms.
3. Theory of Computation: Finite automata, pushdown automata, grammars: type 0, 1, 2, and 3, Turing machines.

4. Compilers: Lexical Analysis, LL and LR grammars, parsing, Flex, Bison

5. Programming: Flow-charts, programming methodologies, 'C', C++, Java.
6. Data Structures and Algorithms: Linked Lists, Stacks, Queues, Binary Search Trees, height balanced trees, AVL trees, Algorithms, searching and sorting methods, Algorithm Design paradigms: divide and conquer, dynamic programming, greedy.
7. DBMS: Database models, query languages, normalization and indexing
8. Operating systems: Process vs thread, CPU scheduling, memory allocation, paging and segmentation, synchronization, deadlocks and prevention, concurrent processing and file management.
9. Computer networks: OSI model vs TCP/IP model, Application layer protocols: HTTP, SMTP, FTP, Skype, Operation of TCP and UDP, IP routing, sunetting, IPv4/1Pv6, network routing algorithms, error control, TDMA/CDMA/FDMA/CSMA, ARQ mechanisms, Ethernet and Wi-Fi.

10. Computer graphics: DDA algorithms, graphic primitives, 2-D transformations, graphic input devices

11. AI techniques: Natural language processing, machine learning, knowledge representation, expert systems, LISP, PROLOG.

12. Software Engineering: Software engineering development life-cycle, system analysis, modular design, testing and validation, CASE tools

10. ELECTRONICS AND COMMUNICATION ENGINEERINg

Section 1: Networks, Signals and Systems

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.
Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.

Section 2: Electronic Devices

Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.

Section 3: Analog Circuits

Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid-frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation.

Section 4: Digital Circuits

Number systems; Combinatorial circuits: Boolean algebra, minimization of functions using Boolean identities and Karnaugh map, logic gates and their static CMOS implementations, arithmetic circuits, code converters, multiplexers, decoders and PLAs; Sequential circuits: latches and flip-flops, counters, shift-registers and finite state machines; Data converters: sample and hold circuits, ADCs and DACs; Semiconductor memories: ROM, SRAM, DRAM; 8-bit microprocessor (8085): architecture, programming, memory and I/O interfacing.

Section 5: Control Systems

Basic control system components; Feedback principle; Transfer function; Block diagram representation; Signal flow graph; Transient and steady-state analysis of LTI systems; Frequency response; Routh-Hurwitz and Nyquist stability criteria; Bode and root-locus plots; Lag, lead and lag-lead compensation; State variable model and solution of state equation of LTI systems.

Section 6: Communications

Random processes: autocorrelation and power spectral density, properties of white noise, filtering of random signals through LTI systems; Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications; Information theory: entropy, mutual information and channel capacity theorem; Digital communications: PCM, DPCM, digital modulation schemes, amplitude, phase and frequency shift keying (ASK, PSK, FSK), QAM, MAP and ML decoding, matched filter receiver, calculation of bandwidth, SNR and BER for digital modulation; Fundamentals of error correction, Hamming codes; Timing and frequency synchronization, inter-symbol interference and its mitigation; Basics of TDMA, FDMA and CDMA.

Section 7: Electromagnetics

Electrostatics; 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, antenna arrays; Basics of radar; Light propagation in optical fibers.

11. ELECTRICAL AND ELECTRONICS ENGINEERING

Section 1: Electric Circuits

Network graph, KCL, KVL, Node and Mesh analysis, Transient response of dc and ac networks, Sinusoidal steady-state analysis, Resonance, Passive filters, Ideal current and voltage sources, Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem, Two-port networks, Three phase circuits, Power and power factor in ac circuits.

Section 2: Electromagnetic Fields

Coulomb's Law, Electric Field Intensity, Electric Flux Density, Gauss's Law, Divergence, Electric field and potential due to point, line, plane and spherical charge distributions, Effect of dielectric medium, Capacitance of simple configurations, Biot-Savart's law, Ampere's law, Curl, Faraday's law, Lorentz force, Inductance, Magnetomotive force, Reluctance, Magnetic circuits,Self and Mutual inductance of simple configurations.

Section 3: Signals and Systems

Representation of continuous and discrete-time signals, Shifting and scaling operations, Linear Time Invariant and Causal systems, Fourier series representation of continuous periodic signals, Sampling theorem, Applications of Fourier Transform, Laplace Transform and z-Transform.

Section 4: Electrical Machines

Single phase transformer: equivalent circuit, phasor diagram, open circuit and short circuit tests, regulation and efficiency; Three phase transformers: connections, parallel operation; Auto-transformer, Electromechanical energy conversion principles, DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, starting and speed control of do motors; Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, no-load and blocked rotor tests, equivalent circuit, starting and speed control; Operating principle of single phase induction motors; Synchronous machines: cylindrical and salient pole machines, performance, regulation and parallel operation of generators, starting of synchronous motor, characteristics; Types of losses and efficiency calculations of electric machines.

Section 5: Power Systems

Power generation concepts, ac and dc transmission concepts, Models and performance of transmission lines and cables, Series and shunt compensation, Electric field distribution and insulators, Distribution systems, Per-unit quantities, Bus admittance matrix, Gauss-Seidel and Newton-Raphson load flow methods, Voltage and Frequency control, Power factor correction, Symmetrical components, Symmetrical and unsymmetrical fault analysis, Principles of over-current, differential and distance protection; Circuit breakers, System stability concepts, Equal area criterion.

Section 6: Control Systems

Mathematical modeling and representation of systems, Feedback principle, transfer function, Block diagrams and Signal flow graphs, Transient and Steady-state analysis of linear time invariant systems, Routh-Hurwitz and Nyquist criteria, Bode plots, Root loci, Stability analysis, Lag, Lead and Lead-Lag compensators; P, PI and PID controllers; State space model, State transition matrix.

Section 7: Electrical and Electronic Measurements

Bridges and Potentiometers, Measurement of voltage, current, power, energy and power factor; Instrument transformers, Digital voltmeters and multimeters, Phase, Time and Frequency measurement; Oscilloscopes, Error analysis.

Section 8: Analog and Digital Electronics

Characteristics of diodes, BJT, MOSFET; Simple diode circuits: clipping, clamping, rectifiers; Amplifiers: Biasing, Equivalent circuit and Frequency response; Oscillators and Feedback amplifiers; Operational amplifiers: Characteristics and applications; Simple active filters, VCOs and Timers, Combinational and Sequential logic circuits, Multiplexer, Demultiplexer, Schmitt trigger, Sample and hold circuits, A/D and D/A converters, 8085Microprocessor: Architecture, Programming and Interfacing.

Section 9: Power Electronics

Characteristics of semiconductor power devices: Diode, Thyristor, Triac, GTO, MOSFET, IGBT; DC to DC conversion: Buck, Boost and Buck-Boost converters; Single and three phase configuration of uncontrolled rectifiers, Line commutated thyristor based converters, Bidirectional ac to dc voltage source converters, Issues of line current harmonics, Power factor, Distortion factor of ac to do converters, Single phase and three phase inverters, Sinusoidal pulse width modulation.

12. ELECTRONICS & INSTRUMENTATION ENGINEERING

1: Electrical Circuits:

Voltage and current sources: independent, dependent, ideal and practical; v-i relationships of resistor, inductor, mutual inductor and capacitor; transient analysis of RLC circuits with dc excitation.

Kirchoff's laws, mesh and nodal analysis, superposition, Thevenin, Norton, maximum power transfer and reciprocity theorems.

Peak-, average- and rms values of ac quantities; apparent-, active- and reactive powers; phasor analysis, impedance and admittance; series and parallel resonance, locus diagrams, realization of basic filters with R, L and C elements.

One-port and two-port networks, driving point impedance and admittance, open-, and short circuit parameters.

Section 2: Signals and Systems:

Periodic, aperiodic and impulse signals; Laplace, Fourier and z-transforms; transfer function, frequency response of first and second order linear time invariant systems, impulse response of systems; convolution, correlation. Discrete time system: impulse response, frequency response, pulse transfer function; DFT and FFT; basics of IIR and FIR filters.

Section 3: Control Systems:

Feedback principles, signal flow graphs, transient response, steady-state-errors, Bode plot, phase and gain margins, Routh and Nyquist criteria, root loci, design of lead, lag and lead-lag compensators, state-space representation of systems; time-delay systems; mechanical, hydraulic and pneumatic system components, synchro pair, servo and stepper motors, servo valves; on-off, P, P-I, P-I-D, cascade, feedforward, and ratio controllers.

Section 4: Analog Electronics:

Characteristics and applications of diode, Zener diode, BJT and MOSFET; small signal analysis of transistor circuits, feedback amplifiers. Characteristics of operational amplifiers; applications of opamps: difference amplifier, adder, subtractor, integrator, differentiator, instrumentation amplifier, precision rectifier, active filters and other circuits. Oscillators, signal generators, voltage controlled oscillators and phase locked loop.

Section 5: Digital Electronics:

Combinational logic circuits, minimization of Boolean functions. IC families: TTL and CMOS. Arithmetic circuits, comparators, Schmitt trigger, multi-vibrators, sequential circuits, flip-flops, 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, 8-bit microprocessor and microcontroller: applications, memory and input-output interfacing; basics of data acquisition systems.

Section 6: Measurements:

SI units, systematic and random errors in measurement, expression of uncertainty accuracy and precision index, propagation of errors. PMMC, MI and dynamometer type instruments; dc potentiometer; bridges for measurement of R, L and C, Q-meter. Measurement of voltage, current and power in single and three phase circuits; ac and dc current probes; true rms meters, voltage and current scaling, instrument transformers, timer/counter, time, phase and frequency measurements, digital voltmeter, digital multimeter; oscilloscope, shielding and grounding.

Section 7: Sensors and Industrial Instrumentation:

Resistive-, capacitive-, inductive-, piezoelectric-, Hall effect sensors and associated signal conditioning circuits; transducers for industrial instrumentation: displacement (linear and angular), velocity, acceleration, force, torque, vibration, shock, pressure (including low pressure), flow (differential pressure, variable area, electromagnetic, ultrasonic, turbine and open channel flow meters) temperature (thermocouple, bolometer, RTD (3/4 wire), thermistor, pyrometer and semiconductor); liquid level, pH, conductivity and viscosity measurement.

Section 8: Communication and Optical Instrumentation:

Amplitude- and frequency modulation and demodulation; Shannon's sampling theorem, pulse code modulation; frequency and time division multiplexing, amplitude-, phase-, frequency-, pulse shift keying for digital modulation; optical sources and detectors: LED, laser, photo-diode, light dependent resistor and their characteristics; interferometer: applications in metrology; basics of fiber optic sensing.

13. ENGLISH

I. Movements and Concepts

Renaissance, Metaphysical poetry, Neo-classicism, Romanticism, Rise of the novel, Modernism, Postmodernism, Colonialism, Postcolonialsim, Diaspora, Psychoanalytical criticism, Myth and archetype, Feminism, Structuralism, Poststructuralism, Deconstruction.

II. Writers and Texts

1)	William Shakespeare	*Hamlet*, *Tempest*
2)	John Milton	*Paradise Lost*-Book 1 and 9
3)	William Wordsworth	"Immortality Ode", *Tintern Abbey*
4)	John Keats	"Ode to a Nightingale", "To Autumn"
5)	Robert Browning	"My Last Duchess", "The Last Ride Together"
6)	**Charles Dickens**	***David Copperfield***
7)	**TS Eliot**	**"The Waste Land", *Murder in the Cathedral***
8)	**GB Shaw**	***Saint Joan***
9)	**Virginia Woolf**	**"A Room of One's Own"**
10)	**Samuel Beckett**	***Waiting for Godot***
11)	**William Golding**	***Lord of the Flies***
12)	**Robert Frost**	**"Home Burial", "The Road Not Taken"**
13)	**Eugene O'Neill**	***The Hairy Ape***
14)	**Toni Morrison**	***Beloved***
15)	**Mulk Raj Anand**	***Untouchable***
16)	**AK Ramanujan**	"Love Poem for a Wife", "Small-Scale Reflections on a Great House"
17)	**Girish Karnad**	***Hayavadana***
18)	**Salman Rushdie**	***Midnight's Children***
19)	**Chinua Achebe**	***Things Fall Apart***
20)	**Margaret Atwood**	***Edible Woman***
21)	**AD Hope**	**"Australia", "Crossing the Frontier"**
22)	**Bessie Head**	*A Question of Power*

III. English Language Teaching

1) ELT in India: (History and status of English in India; English as Second Language, English as Foreign Language, and Ensglish as Global Language).

2) Methods and Approaches: (Grammar Translation method, Direct method, Audio-Lingual method; Structural approach, Communicative language teaching)

3) Teaching of Language Skills: (Teaching of Listening, Speaking, Reading, and Writing Skills; Teaching of Grammar and Functional English; Teaching of Vocabulary; Classroom techniques; Use of authentic materials)

4) Testing and Evaluation: (Principles, Types, Objectives of testing and evaluation)

5) Phonetics and Phonology; Syntax and Structure.

14. GARMENT TECHNOLOGY

Indian Embroidery, Indian Jewellery, Traditional Indian textiles

Embroidery of Kashmir, Sindh, Gujarat, Punjab, Haryana, Himachal pradesh, Bengal, Bihar, Uttar pradesh, Karnataka, Rajasthan, Orissa, Tamilnadu, Gold and Silver embroidery etc

Indian Jewellery – techniques in jewellery work, traditional ornaments-nose ornaments, foot ornaments, head ornaments, girdles, belts, armlets, neck ornaments, bangles etc

Traditional Indian textiles-Kalamkari, Pochampally, Paithani, Patola, Baluchari, anaras brocades, Pabuji Par etc

DYEING AND PRINTING

Bleaching of Cotton, Wool, Silk , man - made fibers Scouring, Singing, desizing Chemical constitution and colour Classification and types of dyes Machinery used in dyeing Methods and styles of printing

Dyeing and printing of cotton, wool, silk, polyester, acrylic, and other synthetic fibers Chemistry of dyestuff intermediates.

Pollution control- air pollution, water pollution, treatment of effluent water, disposal of solid waste.

TEXTILE SCIENCE

Manufacture and properties of – cotton silk, wool polyester, nylon, acrylic, modacrylic, viscose rayon, cuprammonium rayon, cellouse acetate rayon, polypropylene, glass

Yarns – types, count, systems, measurement Ecology and textiles – eco standards , textile process chemicals, toxicological considerations

Textile testing- identification of fibers stain tests solubility tests, fiber analysis, testing of fibers- fiber length, fiber fineness, twist, yarn strength, lea strength, etc., fabric testing – strength, abrasion resistance, air and water permeability, skew ness, etc

Weaving – Yarn calculations, weaving calculations Preparations for weaving, types of looms different types of weaves etc.,

Knitting, Braiding, Lace, felt, etc., methods of making fabric Wet spinning, melt spinning, and dry spinning Texturizing Finishes – ammoniating mercerizing shrinking, stiffening, weighting, calendaring, glazing, schreinerizing, embossing, moireing, cireing, beetling, raising, napping, wrinkle, resistant finishes, soil repellent finishes, flame retardant finishes, mildew proof finishes etc., Detergents – fats and oils, surfactants and surface activity, soap manufacture, synthetic detergents, analysis of detergents Textile terminology.

CLOTHING

Basic stitches – rentering stitch, hemming, back stitch, quick overcastting, overcasting, deeper over casting, over handling, stoating stich etc.,

Seams and seam finishes – plain, welt, flat fell, strap, slot, French, upholsterer's, corded, lapped, imitation French , laced seams, top stitch seam, etc.,

Working of embroidery stitches

Methods of handling finishes – Casing, gathers, shirring, smocking, tucks, pleats, godets, darts, etc.,

Neck line finishes – combination facings ,applying shaped facings to neckline with zipper, applying shaped facing to neckline and garment opening , applying bias facing , applying cording to faced neck line ,application of single and double layer binding ,decorative facings etc Drafting and stitching of sleeves – cap sleeve , basic Bishop sleeve ,exaggerated Bishop sleeve, Bell sleeve , puff sleeve , petal sleeve , lantern sleeve ,cowl sleeve , wedding sleeve , Kimono sleeve ,Dolmon sleeve ,Raglon sleeve etc

Drafting and stitching of collars – shirt collar, shawl collar, mandarin collar, turtle neck collar, sailor collar ,puritan collar ,etc

Drafting and stitching of pockets – patch, bound, in seam pockets etc Drafting and stitching of yokes Drafting and stitching of skirts Underlying fabrics – linings , inter linings, interfacings , underlying (selection ,types , applications etc)

preparation of material for cutting – preparation of woven and knitted fabrics for cutting Handling of fabrics – velvet, velveteen, bonded, stretch, knit, lace, wash and wear, silk, laminated , napped, leather, jersey sheer fabrics etc

(selection of pattern, shrinking, cutting , marking, selection of inter facing , basting, selection of thread and needle , stitch length , seam finishes , button holes , hems , linings , pressing etc) Pattern alterations – alterations to trousers , skirts , blouse , alterations based on figure irregularities etc

Care of fabrics – darning and patching , washing of different fabrics , dry cleaning – types of equipment used in dry cleaning , methods of dry cleaning , pressing of garments ,pressing equipments etc. Dart manipulation.

APPAREL MANUFACTURING , MARKETING AND MERCHANDISING

Cutting , production analysis – types of spreads , spreading equipment and tools , spreading methods analysis , cutting equipment , cutting methods analysis , types of marker and spreading materials , cost and quality principles governing markers , training cutting production personnel etc

Fabric grading – grey state fabric grading, conventional system of grading, point system of grading , finished fabric grading

Defects –spinning defects , sizing defects , warp defects , filling defects , other weaving defects , bleaching and finishing defects , dyeing defects , printing defects , stains etc Machinery used in apparel industry

Time and motion study Quality control Production systems Pricing strategies Marketing ethics Product services Marketing environment

FASHION DESIGNING

Principles of designing Elements of design Colour theory Selection of apparel
Selection of accessories Classification of fashion Fashion terminology Selection of fabric design Illusion in designing. Works of Indian and international designer's Western fashions.
Fashion trends in different periods Display of garments.

15. GEOLOGY

1. Geomorphology and Remote Sensing

Basic principles, weathering and soils, mass wasting, influence of climate on processes. Concept of erosion cycles. Geomorphology of fluvial tracts, arid zones, coastal regions, karst landscapes and glaciated ranges. Applications of Geomorphology in mineral prospecting, civil engineering, hydrology and environmental studies, topographical maps and geomorphology of India.

Concepts and principles of aerial photography and photogrammetry Satellite Remote Sensing. Fundamentals of Digital Image Processing. Use of Remote Sensing in landforms, landuse, and structural mapping, Hydrogeological studies and mineral exploration. Geographic Information System (GIS) – principles and applications.

2. Structural geology and Geotectonics

Principles of geological mapping and map reading, projection diagrams, stress-strain relationship of elastic, plastic and viscous materials. Behavior of minerals and rocks under deformation conditions. Structural analysis of folds, cleavages, lineation's, joints, and faults. Superposed deformation. Mechanism of folding and faulting. Unconformities and basement cover relations. 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-geological, geophysical and other evidences, mechanics, objections and present status. Gravity and magnetic anamolies at 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, epeirogeny, geosynclines, and seismic belts of the earth. Seismicity and plate movements. Geodynamics of the Indian plate.

3.Stratigraphy

Nomenclature and the modern stratigraphic code. Radio isotopes and measuring geological time. Geological time scale, stratigraphic procedures of correlation of unfossiliferous rocks. Precambrian stratigraphy of India. Stratigraphy of the Paleozoic and Mesozoic and Cenozoic formations of India. Gondwana system and gondwana land, and origin of Himalaya and evolution of Siwalik basin, Deccan volcanic. Quaternary stratigraphy, rock record, paleoclimates and paleogeography.

4. Paleontology

Fossil records, morphology and time ranges fossil groups. Evolutionary changes in Mollusks and mammals in geological time. Principles of evolution. Use of species and genera of foraminifera and echinodermata in biostratigraphic correlation. Siwalik vertebrate fauna and flora, different microfossil groups and their distribution in India.

5. Crystallography and Mineralogy

Physical, chemical and crystallographic characteristic of common rock forming mineral group. Silicate structures. Common minerals of igneous and metamorphic rocks. Minerals of the carbonate, phosphate, sulphide, halide and oxide groups.

Optical properties of common rock forming silicate minerals, uniaxial and biaxial minerals. Extinction, plechroism, birefringence of mineral and their relation with mineral composition. Twinned crystals and dispersion of optic axis and crystallographic axis.

6. Igneous and Metamorphic petrology

Forms, textures, and structures of igneous rocks, silicate melt equilibria, binary and ternary phase diagrams, Petrology and geotectonic evolution of granites, basalts, andesites and alkaline rocks. Petrology of gabbros, kimberlites, anorthosites and carbonatites. Origin and evolution of magmas.

Textures and structures of metamorphic rocks. Regional and contact metamorphism of pelitic and impure calcareous rocks. Mineral assemblages and P/T condition.

Characteristics of different grades and facies of metamorphism, Metasomatism and granitization, magmatites. Plate tectonics and metamorphic zones. Paired metamorphic belts.

7. Sedimentology

Provenance and digenesis of sediments, Sedimentary textures. Framework matrix and cement of terrigenous sediments. Definition, measurement and interpretation of grain size. Elements of hydraulics, primary structure, paleocurrent analysis. Biogenic and chemical sedimentary structures. Sedimentary environment and facies. Facies modeling for marine, non marine and mixed sediments. Tectonics and sedimentation. Classification and definition of sedimentary basins, sedimentary basins of India. Cycle sediments. Seismic and sequence stratigraphy. Purpose and scope of basin analysis. Structure contours and isopach maps.

8. Geochemistry

Earth in relation to the solar system and universe, cosmic abundance of elements. Composition of the planets and meteorites. Structure and composition of earth and distribution of elements. Trace elements. Elementary crystal chemistry and thermodynamics. Introduction to isotope geochemistry. Geochemistry of hydrosphere, biosphere and atmosphere. Geochemical cycle and principles of geochemical prospecting. Origin of elements.

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 withdrawl 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 methods. Environmental protection-legislative measures in India. Factors for groundwater subsidence.

10.Indian mineral deposits and mineral economics

Occurrence and distribution of metalliferous deposits-base metals, iron, manganese, alluminium, platinum, chromium, nickel, gold, silver, molybdenum. Indian deposits of non metals-mica, asbestos, barite, gypsum, apatite and beryl. Phosphrite, placer and rare earth mineral deposits. Gemstones, raw materials used for refractories, abrasives, glass, fertilizers, paints, ceramics and cement industries.

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.

11. Ore genesis

Ore deposits and ore minerals. Magmatic processes of mineralization, porphyry, skarn, and hydrothermal mineralization. Fluid inclusion studies and paragenesis. Mineralization associated with – i. ultramafic, mafic and acid rocks, ii. Greenstone belts, iii. Komatites, anorthosites and kimberlites, iv, Submarine volcanism-volcanogenic deposits. Magma-related mineralization through geological time. Stratiform and stratabound ores. Syngenetic deposits, residual and mechanical concentration processes, supergene sulphide and oxide enrichments.

12. Mineral exploration

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. Instrumental techniques of detection and measurement of radio activity. Radio active methods for prospecting and assaying of mineral deposits. Geomorphological and remote sensing techniques. Geobotanical and geochemical methods. Bore hole logging and survey for deviation.

13. Fuels

Definition, 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 radio active minerals in India. Radio active methods in petroleum exploration-well logging techniques. Nuclear waste disposal-geological constraints.

14. Engineering geology

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

15. Hydrogeology

Origin of water-meteoric, juvenile, and connate. Hydrological cycle-evaporation, precipitation, runoff. Hydrographs, water table contour maps. Rock properties affecting groundwater. Types of aquifers. Porosity, permeability, specific yield and retention, hydraulic conductivity, trasmitssivity, storage and storage coefficient.

Well hydraulics, general flow equations, study of unidirectional flow, radial flow to a well, unsteady radial flow in a confined and unconfined aquifer. Water level fluctuation and causative factors. Methods of pumping tests and analyses, evaluation of aquifer parameters. Artificial recharge of groundwater. Groundwater legislation. Sustainability criteria and managing renewable and non-renewable groundwater resources.

Groundwater quality-sources of salinity, estimation of major elements, interpretation of chemical analyses. Groundwater pollution, arsenic and fluoride problems. Groundwater quality maps of India. 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.

16. MARINE ENGINEERING

1. **Mechanics of Solids:** Static all indeterminate Beams - Fixed and Continuousbeams, Analysis B.M. and S.F. diagrams. Columns and Struts, Stresses due to rotation. Thick and Thin cylinders, The oriesof failure, Torsional stress esinshafts.
2. **Theory of Ships:**Ship related terms and their definitions, Stability of ships and freeboard, Trim and effects of changes in draught. Sub division of ships, Launching types, General layout of ships, Ship structure, Accommodation in ships, Classification Societies, Life saving appliances and Navigational aids, Tonnage measurement, Marine pollution.

Ship Design : Design Methods, Estimation of Weight and Volume Components, Design of Hull Form Determination of Engine Power and Selection of Main and Auxiliary machinery, design consideration for special ships and use of computers, changes effect edoverthe years, Design features of special types of ships, Role of International andNational regulatory Bodies.

3. **Ship Structures :** ship structures, functions and analysis, Longitudinal strength, Ultimate strength and Transverse strength of hull girder, ship hull material, Strength of bulk heads, decks and tank tops, foundations, super structure, deck houses and structural discontinuities, Theory of thin plates, buckling of structures, composite construction, grillage analysis,calculationof scantlings.

4. **Marine Machinery:** Marine and Special Duty pumps, Ejectors, Strainers and Filters, Coolers, Centrifuges, Purifiers and clarifiers-their purpose, construction and operation, Marine Piping, evaporators, distillers, valves and fittings, pipes materials and corrosion, color codes for different pipes, Deck equipments, Hull fittings, Anchors and Mooring gear .Ship transmission system, Stern tubes and glands-oil lubricated stern tubes, shaft seals, shaft alignment, thrust block, reduction gearing.

5. **Ship Resistance and Propulsion:** Resistance types, estimation of to talresistance and effective horsepower, Propeller Design and hull propeller interaction, prediction of ship's power and strength of propellers, Classification of Power Plants, Construction, Operation and maintenance of Marine boilers, Steam engines, Marine Steam turbines, Marine IC Engines, Marine Gas turbines, hydro - electric, Nuclear and Solar powerpropulsion and their combinations, FuelConsumptionunder varyingconditions,.

6. **Ship Systems:** Operation and Maintenance of Marine Refrigeration and Air Conditioning, temperature and humidity control-comfort conditioning, Cabin and cargo ventilation-piping and ducting-insulating materials, liquid cargo handling in tankers, cargo pipe layout systems- loading, unloading, ventilation, cleaning, Fire fighting systems-fixed and portable, ship electrical systems, Fuel and lubricating oil systems, Fresh water and sea water systems, communication systems, waste heat recovery systems, Hot water, drinking water, Bilge and Ballast systems-sewage disposal system.
7. **Ship Construction:** Ship building materials, Ship yard layout, Various departments and works hop sina shipyard, facilities and services, Surface preparation, Joining methods of materials, non-destructive testing, ship construction stages, launching, dock and sea trials, hull protection methods, Floating Docks, Bollard tests, Out fitting.
8. **Sea Keeping And Manoeuverability:** Sea keeping, Ship motion sin regular waves, Ship Motion sin Irregular waves, Dynamic effects, Roll and Pitch stabilization methods,

Introduction to Maneuverability, Control Surfaces, Steering gear stypes-construction, operation and maintenance, automation of ship systems and ship operation.

9. **Ship Vibration:** Hull Vibration and Pro pellerexciting forces, Types of damping, Special local vibration problems–Rudder vibration, cavitations, stress and vibration levels, General methods of reducing vibrations, Devices for reducing main hull vibration, Synchronizing devices fort win–screw ships, rotating weight neutralizers, Kurt nozzles.

17. Mathematics

1. Real Analysis

- Countable and uncountable sets — Real number system—lub and *glb* of a subset of real line.
- Cauchy, monotone and convergent sequences — subsequences — BolzanoWeierstrass theorem.
- Tests of convergence of infinite series.
- Continuous and uniform continuous functions — Intermediate value theorems.
- Differentiable functions — Mean value theorems.
- Riemann integrable functions.
- Sequence and series of functions.
- Metric spaces — completeness, compactness and connectedness. —Heine Borel theorem.

2. Complex Analysis

- Algebra of complex numbers — complex plane
- Analytic functions — Cauchy-Riemann equations
- Fractional linear transformation — Mobius transformation.
- Harmonic functions — Mean value property — Maximum principle.
- Complex integration — Cauchy theorem
- Cauchy integral formula — Liovelle's and Morera's theorem
- Power series — radius of convergence — manipulation.
- Taylor and Laurent series.
- Calculus of residues

3. Linear Algebra

- Vector spaces — subspaces — Quotient space
- Linear dependence and independence — basis — dimension.
- Inner product space — orthogonal basis Gram Schmidt process.
- Linear transformation — rank nullity theorem — matrix of a linear transformation with respect to a basis — change of basis.
- Singular and non singular matrix — inverse of a matrix.
- Eigen value and eigen vectors — characteristic polynomial — Cayley-Hamilton theorem
- D iagonalizat ion

4. Algebra

- Groups, subgroups, normal subgroups — Lagrange's theorem
- Quotient groups — homomorphism and isomorphism theorems.
- Permutation grOups, cyclic groups
- Cayley's theorem, Sylow's theorem and applications.
- Rings, subrings, — quotient rings — homomorphism and isomophisms
- integral domains, fields
- Ideals, prime ideals, maximal ideals
- Polynomial rings — irreducible polynomials
- Euclidean domain, principle ideal domains

5. Differential equation

- First order linear ordinary differential equations (ODE) — solutions — Exact differential equations and integrating factors.

- First order non-linear equations — solutions — singular solutions.
- Second order linear equations — solutions — Wronskian — variation of parameters.
- Linear higher order equations with constant coefficients and specific variable coefficients
- Formation of partial differential equation (PDE) — geometry of solution — types of solution
- Cauchy problem for first order PDE — characteristic curves
- Compatible systems, Lagrange and Charpit method of solving first order PDE.
- Classification of second order PDEs. Examples of three types.

18. MECHANICAL ENGINEERING

Fluid Mechanics

Fluid properties— density, viscosity, surface tension; Fluid Statics— Hydrostatics, Fluid forces on planes and curved surfaces, submerged and floating bodies, Buoyancy and stability, Fluid Concepts —Streamlines, streaklines, pathlines, viscous vs inviscid flows, laminar vs turbulent flows, compressible v/s incompressible flows; Bernoulli equation; Control Volume analysis: Basic laws — Mass conservation law, thermodynamic laws, Newton's laws, Angular-Momentum principle; Flows in a pipes and channels - friction factor, flow measurement devices — Venturi meter, Orifice meter. Governing equations of fluid flows— continuity, Euler equations, Navier-Stokes equations, internal flows; external flows, Flow separation;

Thermodynamics

Thermodynamic system and control volume, properties and state of a substance, process and cycles, energy, pressure and temperature, Zeroth law, Properties of pure substance, work and heat, First law of thermodynamics, first law analysis for a control volume, Second law of thermodynamics, Entropy, Second law analysis for a control volume, irreversibility and availability, power and refrigeration cycles —Carnot cycle, Brayton cycle, Diesel cycle, Otto cycle, Stirling cycle, Rankine cycle, vapour compression refrigeration cycle and their variants

Material Science

Crystal geometry and structure determination, structure of solids, crystal imperfections, Phase diagram, diffusion in solids, phase transformations, elastic anelastic and visco-elastic behaviour, phase deformation and creep in crystalline materials, fracture, conductors, resistors, semi-conductors, magnetic materials, dielectric materials

Engineering Mechanics and Strength of Materials

Definition for rigid body, statics, dynamics (kinematics and kinetics); Idealization in mechanics; Vector operations; Resultant of system of coplanar forces (parallelogram and triangular construction); Free body· diagram; Resolution of forces in 3D; Equilibrium equation; Shear Force and Bending Moment Diagram; Analysis of trusses — Method of joints and Method of sections; stability of trusses; space trusses; Mass and Geometric properties of members — Centre of gravity and moment of inertia for simple geometries; Parallel and Perpendicular — axes theorem; Kinematics and dynamics of rigid bodies; Virtual work done; Energy method for particles. Tension, compression and shear stresses, axially loaded members, torsion, beam bending, transverse shear, combined loading, and impact loading, deflections of beams, energy methods, analysis of stress and strain, stress transformation, applications of plane stress, pressure vessel, column buckling, and statically indeterminate structures.

Manufacturing Processes

Methods of manufacturing with metals — Basic Principles, Processes, equipment, process variables: Casting - Fundamentals, various types of casting processes; Forming — Rolling, Forging, Extrusion and Drawing, Sheet Metal Forming; Joining — Welding, Brazing, Soldering, Bonding and Mechanical Fastening; Non-Traditional Manufacturing - Thermo-mechanical Processes, Thermo-electrical Processes, Chemical Processes, Thermo-chemical Processes, Hybrid Processes

Applied Thermodynamics

IC Engines - Classification, Basic Working Principles, Components and Engine Operating Events of an IC Engine; Engine Operating Parameters: Geometry, Torque, Power and Work; Fuel Consumption and Efficiencies; SI and CI Engine Cycle Models: Basic Thermodynamic and Thermo-chemistry Analysis
Turbo-machine: Basic Principles, Two-dimensional cascades, Thermodynamic analysis of axial flow turbines, axial flow compressors, centrifugal pumps, compressors and hydraulic turbines

Boilers and Condensers: Fire-tube boiler, Water tube boiler, high pressure boilers, boiler draught and performance; types of condensers, jet condenser, surface condenser, condenser efficiency, cooling tower and pond

Reciprocating Air Compressor: Compressed air systems, reciprocating air compressor, thermodynamic analysis, efficiency, free air delivery

Heat Transfer and Refrigeration

Modes of heat transfer, heat conduction — 10 steady state, 10 transient, fins; convective heat transfer — natural and forced convection, convective heat transfer corelations, condensation and boiling, heat exchangers — LMTD and NTU methods. Vapour compression refrigeration systems, types of refrigerants, components in a refrigeration systems — pumps, condensers, expansion devices, evaporators; gas cycle refrigeration, vapour absorption system.

Machine Design

Design consideration-limits, fits, tolerances and standardization, modes of failure, failure theories. Design of shafts under static and fatigue loadings. Design of springs - helical, compression, tension, torsional and leaf springs. Design of joints — threaded fasteners, preloaded bolt joints, welded and glued joints. Design and analysis of sliding and rolling contact bearings. Analysis and applications of power screws and couplings. Analysis of clutches and brakes. Design of belt and chain drives. Design of spur, helical, bevel and worm gears.

Machine Drawing and Solid Modelling

Principle of drawing. Introduction to machine drawing, production drawing, assembly drawing. Different sectional views. Fits, limits, tolerances and surface finish. Solid modelling of different machine elements. Example, threads, bolts, and nuts, welded and riveted joints, shafts, keys, cotter, and pin joints; couplings and clutches, springs, belts, and pulleys; bearings, gears. Assembly of different components of IC engine

Theory of Machines

Introduction to mechanisms, Links, Kinematic pairs, Kinematic chains, Mechanism and Inversions, Kennedy's theorem, Velocity and acceleration in mechanism, Relative velocity methods, Instantaneous center of rotation, Acceleration diagram, Acceleration center. Cams: Synthesis of translating flat-face, translating roller and oscillating roller follower cams. Gears: terminology, fundamental law of gearing, involute profile, Interference and undercutting, minimum number of teeth, contact ratio, bevel helical, spiral and worm gears, Gear Trains —simple, compound and epicyclic gear trains; sliding gear boxes and synchronous gear boxes.

Production Engineering

Principles of Metal cutting: orthogonal and oblique cutting; mechanics of machining; Machine Tools turning, milling, shaping, drilling: Construction and working; Process variables; Cutting tools —nomenclature, material and tool life; Machinability ; Abrasive machining processes- grinding, honing, lapping, burnishing and super finishing: Equipment, process variables and surface features; Surface integrity concepts. Introduction to NC and CNC: Concepts and programming — Constructional features of various machine tools; Introduction to computer integrated manufacturing.

Metrology : Fundamentals of measurements: Errors, Length Standards, Gauging, Comparators, limits & Fits and Tolerances; Role of metrology in quality assurance; Measurement of geometric forms , Flatness, Straightness, form errors; Slip gauges; Surface finish measurements; Coordinate measuring machines; Vision applications in Metrology; Optical metrology and laser interferometry; Nano measurements

industrial Engineering

Management functions, Evolution of Management Theory, Management approach to Planning, Analysis and Control functions involved in a Production System; Production cycles, planning functions; Types of industry : Job, Batch, Continuous, Mass and Flow Productions; Organisation and policies in respect of production planning and control; Product design and development; Forecasting techniques; Scheduling, Sequencing and plant loading for optimal utilization; Queueing models and line balancing; Materials Planning and Control, Inventory Management; Value Analysis; Productivity Analysis, Mechanics of production control.

19. METALLURGICAL ENGINEERING

Section 1: Thermodynamics and Rate Processes

Laws of thermodynamics, activity, equilibrium constant, applications to metallurgical systems, solutions, phase equilibria, Ellingham and phase stability diagrams, thermodynamics of surfaces, interfaces and defects, adsorption and segregation; basic kinetic laws, order of reactions, rate constants and rate limiting steps; principles of electro chemistry- single electrode potential, electrochemical cells and polarizations, aqueous corrosion and protection of metals, galvanic corrosion, crevice

corrosion, pitting corrosion, intergranular corrosion, selective leaching, oxidation and high temperature corrosion - characterization and control; heat transfer - conduction, convection and heat transfer coefficient relations, radiation, mass transfer - diffusion and Fick's laws, mass transfer coefficients; momentum transfer - concepts of viscosity, shell balances, Bernoulli's equation, friction factors.

Section 2: Extractive Metallurgy

Minerals of economic importance, comminution techniques, size classification, flotation, gravity and other methods of mineral processing; agglomeration, pyro-, hydro-, and electro-metallurgical processes; material and energy balances; principles and processes for the extraction of non-ferrous metals - aluminium, copper, zinc, lead, magnesium, nickel, titanium and other rare metals; iron and steel making - principles, role structure and properties of slags, metallurgical coke, blast furnace, direct reduction processes, primary and secondary steel making, ladle metallurgy operations including deoxidation, desulphurization, sulphide shape control, inert gas rinsing and vacuum reactors; secondary refining processes including AOD, VAD, VOD, VAR and ESR; ingot and continuous casting; stainless steel making, furnaces and refractories.

Section 3: Physical Metallurgy

Crystal structure and bonding characteristics of metals, alloys, ceramics and polymers, structure of surfaces and interfaces, nano-crystalline and amorphous structures; solid solutions; solidification; phase transformation and binary phase diagrams; principles of heat treatment of steels, cast iron and aluminium alloys; surface treatments; recovery, recrystallization and grain growth; structure and properties of industrially important ferrous and non-ferrous alloys; elements of X-ray and electron diffraction; principles of optical, scanning and transmission electron microscopy; industrial ceramics, polymers and composites; introduction to electronic basis of thermal, optical, electrical and magnetic properties of materials; introduction to electronic and opto-electronic materials.

Section 4: Mechanical Metallurgy

Elasticity, yield criteria and plasticity; defects in crystals; elements of dislocation theory - types of dislocations, slip and twinning, source and multiplication of dislocations, stress fields around dislocations, partial dislocations, dislocation interactions and reactions; strengthening mechanisms; tensile, fatigue and creep behaviour; superplasticity; fracture - Griffith theory, basic concepts of linear elastic and elastoplastic fracture mechanics, ductile to brittle transition, fracture toughness; failure analysis; mechanical testing - tension, compression, torsion, hardness, impact, creep, fatigue, fracture toughness and formability.

Section 5: Manufacturing Processes

Metal casting - patterns and moulds including mould design involving feeding, gating and risering, melting, casting practices in sand casting, permanent mould casting, investment casting and shell moulding, casting defects and repair; Hot, warm and cold working of metals; Metal forming - fundamentals of metal forming processes of rolling, forging, extrusion, wire drawing and sheet metal forming, defects in forming; Metal joining - soldering, brazing and welding, common welding processes of shielded metal arc welding, gas metal arc welding, gas tungsten arc welding and submerged arc welding; Welding metallurgy, problems associated with welding of steels and aluminium alloys, defects in welded joints; Powder metallurgy - production of powders, compaction and sintering; NDT using dye-penetrant, ultrasonic, radiography, eddy current, acoustic emission and magnetic particle methods.

20. MINING ENGINEERING

Section 1: Mine Development and Surveying

Mine Development: Methods of access to deposits; Underground drivages; Drilling methods and machines; Explosives, blasting devices and practices.

Mine Surveying: Levels and leveling, theodolite, tacheometry, triangulation; Contouring; Errors and adjustments; Correlation; Underground surveying; Curves;

Photogrammetry; Field astronomy; EDM and Total Station; Introductory GPS .

Section 2: Geomechanics and Ground Control

Engineering Mechanics: Equivalent force systems; Equations of equilibrium; Two dimensional frames and trusses; Free body diagrams; Friction forces; Particle kinematics and dynamics; Beam analysis.

Geomechanics: Geo-technical properties of rocks; Rock mass classification; Instrumentation and stress measurement techniques; Theories of rock failure; Ground vibrations; Stress distribution around mine openings; Subsidence; Rock bursts and coal bumps; Slope stability.

Ground Control: Design of pillars; Roof supporting systems; Mine filling.

Section 3: Mining Methods and Machinery

Mining Methods: Surface mining: layout, development, loading, transportation and mechanization, continuous surface mining systems; Underground coal mining: bord and pillar systems, room and pillar mining, longwall mining, thick seam mining methods; highwall mining; Underground metal mining: open, supported and caved stoping methods, stope mechanization, ore handling systems.

Mining Machinery: Generation and transmission of mechanical, hydraulic and pneumatic power; Materials handling: haulages, conveyors, face and development machinery, hoisting systems, pumps, crushers.

Section 4: Surface Environment, Mine Ventilation, and Underground Hazards

Surface Environment: Air, water and soil pollution : Standards of quality, causes and dispersion of contamination, and control; Noise; Land reclamation.

Mine Ventilation: Underground atmosphere; Heat load sources and thermal environment, air cooling; Mechanics of air flow, distribution, natural and mechanical ventilation; Mine fans and their usage; Auxiliary ventilation; Ventilation planning; Ventilation networks.

Subsurface Hazards: Mine Gases. Underground hazards from fires, explosions, dust and inundation; Rescue apparatus and practices; Safety in mines; Accident data analysis; Mine lighting; Mine legislation; Occupational safety.

Section 5: Mine Economics, Mine Planning, Systems Engineering

Mine Economics: Mineral resource classification; Discounted cash flow analysis; Mine valuation; Mine investment analysis; Mineral taxation.

Mine Planning: Sampling methods, practices and interpretation; Reserve estimation techniques: Basics of geostatistics and quality control; Optimization of facility location; Work-study.

Systems Engineering: Concepts of reliability; Reliability of simple systems; Maintainability and availability; Linear programming, transportation and assignment problems; Network analysis; Inventory models; Queueing theory; Basics of simulation.

21. PHARMACY

PHARMACEUTICS

- History of Pharmacy: Development of Pharmacy education
- Pharmacy literature : History and Development of IP., BP., USP, BPC, NF OF INDIA and extra Pharmacopoeia.
- History of Ayurveda.
- Principles of dispensing- Prescription handling, pricing and refilling of Prescription, containers, labelling and packing.
- Posology : Definition, factors influencing doses, calculation of doses.
- Unit Operations: Size Reduction, Size Seperation, Mixing, Evaporation, Distilllation, Extraction, Drying, Sterilization, Filteration, crystallization, centrifugation, Dehumidification and humidity control

- Principles Involved and procedures adopted in the preparation and dispensing of the following classes of pharmaceutical preparations solid, liquid, semisolid, parenteral dosage forms and Aerosols.
- Incompatability: Physical, chemical and therapeutic incompatabilities, methods of overcoming and handling of incompatible prescriptions.
- Cosmetic preparations : General aspects of face , hands ,body , hair , dental , shaving preparations
- Novel Drug Delivery Systems : Oral, Transdermal, Mucoadhesive and Targeted drug delivery systems.
- General principles of immunology, serology and their applications.

PHARMACEUTICAL CHEMISTRY

- Sources of impurities in pharmaceutical substances, Limit tests for chloride ,sulphate arsenic, lead ,iron. Qualitative tests for anions and cations .
- Systematic study of the following pharmaceutical inorganic and organic compounds with reference to their preparations , properties , test for identity, purity , pharmaceutical uses and assay methods.

INORGANIC

- Electrolytes: sodium and potassium replenishers , calcium replenishers; acid base regulators, dialysis fluids . Mineral nutrients and supplements
- Gastro intestinal agents —acidifiers and antacids ,adsorbents, laxatives. Haematinics , Pharmaceutical aids , Expectorants - ammonium chloride , potassium iodide , Antidote -- sodium thiosulphate , sodium nitrite, Topical agents — astringents , protectants , silicone polymers-activated dimethicone , anti infectives , dental products-oral antisepics and astringents.

ORGANIC

- Study of hydrocarbons, carbonyl compounds , carboxyl acids and derivatives , nitrogen , halogens hydroxy compounds and ethers ; Study of hetero cyclic systems , five membered and six membered ring systems with 1-3 hetero atoms ; mechanism and application in drug synthesis of named reactions such as Beckmann 's and Fries rearrangement ,Phillips's condensation reaction, Mannich , Michael addition reaction .

MEDICINAL CHEMISTRY

- Nomenclature , classification ,structures ,mechanism of action ,SAR ,uses and synthesis of:-

  Antibiotics - Penicillins, Cephalosporin , Tetracyclines, Aminoglycosides
  Steroids —Cholesterol, Diosgenin , Stigmasterol , Ergosterol .
  Vitamins , Hormones , Alkaloids , Terpenoids.
- Drug Discovery, Drug Design
- Instrumentation and Pharmaceutical applications of UV, Visible IR, Spectrophotometry, , Fluorimetry, Refractometry, Polarimetry, , Conductometry, Electrophoresis , Flame Photometry .

PHARMACOGNOSY

- Determination of leaf constants, identification of crude drugs , identification of fibres by chemical tests, determination of ash values , extractive values, swelling factor and foreign organic matter .
- Study of mineral drugs, tannins.
- Study of biological sources, cultivation , collection , chemical constituents , substitutes ,adulterants , uses ,microscopic features of Liquorice, Digitalis ,Senna , Chirata , Lobelia, Belladonna ,Cinchona , Rauwolfia, Ephedra , Vasaka
- General techniques of biosynthetic studies and basic metabolic pathways .
- Brief introduction to biogenesis of secondary metabolites of pharmaceutical importance.

BIOCHEMISTRY

- Carbohydrate , Protein and Amino acid , Lipid metabolism, nucleic acid metabolism , biological oxidation..
- Enzymes, Mechanism, kinetics, enzyme inhibition, factors affecting enzyme action, isoenzymes, co-enzymes, metaloenzymes, allosteric-enzymes, clinical and therapeutic uses of enzymes.
- Role of minerals and water in biochemical processes .
- Qualitative and Quantitative measurement of Glucose, Urea, Cholesterol , Bile salts, Bile pigments , Creatinine , Calcium phosphates, SGPT,and SGOPT in Blood and abnormal constituents in urine .

INTRODUCTION TO ANATOMY & PHYSIOLOGY & PHARMACOLOGY

- Comprehensive knowledge of the anatomical consideration in relation to Nervous system (central and autonomic nervous system), Urinary system , Reproductive system, Digestive system, Respiratory system , Endocrine system , Blood and Blood forming organs , Lymphatic system, Cardiovascular system and Special Senses.
- Concept of Health and Diseases, Disease causing agents, prevention , communicable diseases —causative agents , modes of transmission and prevention of Chicken Pox , Measles , Influenza , Diphtheria , Whooping Cough , Tuberculosis , Poliomyelitis , Hepatitis , Cholera , Typhoid, Helminthlasis , Malaria , Filariasis , Rabies, Trachoma, Tetanus, Leprosy, Syphilis, Gonorrhea and AIDS ,family planning methods and devices.
- Types and preparation of media , theory of staining , Isolation and preservation of cultures , study of bacterial growth. Microbiology of air ,water and milk .
- Pharmacokinetics, Pharmacodynamics, Molecular mechanisms.
- Pharmacology of drugs acting on Autonomic nervous system, Central nervous system, Cardiovascular system , gastrointestinal tract , Excretory system ,Blood and respiratory systems.

PHYSICAL PHARMACY

- Theory and application of interfacial phenomenon , Colloids , Rheology, Micromeritics , Chemical kinetics , Complexation and Protein binding , Thermodynamics.

DRUG STORE MANAGEMENT AND PHARMACY ADMINISTRATION

- Goals of Production Management and Organization , Distribution , Drug store planning and layout , Sales Promotion , Inventory control, Elements of industrial Accountancy.

HOSPITAL & CLINICAL PHARMACY

- Objectives , functions , organization , planning , location layout of Hospital Pharmacy. Drug distribution to out patients and inpatients. Hospital drug policy : General considerations.
- Pharmacy and therapeutic committee - organization, formulary content, preparation and distribution, Hospital committees, Hospital manufacturing, patient data analysis .
- Basic and general principles of drug therapy: monitoring of drug therapy, adverse drug reactions, drug interactions, toxicology- types of poisons , general principles of treatment , types of antidote.
- Statistical inferences : Common parametric and non-parametric tests employed in testing of significance in Biological / Pharmaceutical experiments and elements of ANOVA(one way and two ways)

Forensic / Pharmaceutical jurisprudence

- Development of Pharmaceutical and drug legislation in India.
- The Pharmacy act, 1948, Drugs and cosmetics act 1940 and Drugs and cosmetics rules 1945.

- Drugs and magic remedies act, The Medicinal and Toilet preparation act, Drugs Price Control order, Legislations to control the operations regulating the dangerous drugs,, poisons and opium , The narcotic drugs and psychotropic substances act, 1985.
- Industries act, 1951, the Indian patents and design act, 1970 with reference to the drugs and Pharmaceuticals, prevention of food adulteration act.(acquaint with amendments to above acts)
- Pharmacy ethics : Introduction to code of ethics of Pharmacy, Pharmaceutical ethics , ethical guidelines for retail pharmacist, community ,manufacturing pharmacist and Pharmaceutical researcher.

22. PHYSICS

I. Mathematical Methods of Physics:

Dimensional analysis, Vector algebra and vector calculus, Linear algebra, matrices, Caley-Hamilton theorem, Eigenvalue and eigenvectors, Linear ordinary differential equations of first and second order, Special functions (Hermite, Bessel, Laguerre and Legendre). Fourier series, Fourier and Laplace transform. Elements of complex analysis, analytic functions: Taylor and Laurent series; poles, residues and evaluation of integrals. Elementary probability theory, random variables, binomial, Poisson and normal distributions. Central limit theorem. Data interpretation and analysis, Precision and accuracy. Error analysis, propagation of errors. Least square fitting, linear and nonlinear curve fitting and Chi-square test. Introductory group theory; SU(2), 0(3).

II. Classical Mechanics:

Newton's laws, Phase space dynamics, stability analysis, Central force motion. Two body collisions, scattering in laboratory and center-of-mass frames, Rigid body dynamics, moment of inertia tensor, Non-inertial frames and pseudoforces. Variational principle, Generalized coordinates, Lagrangian and Hamiltonian formalism and equations of motion. Poisson brackets and canonical transformations, Symmetry, invariance and Conservation laws, cyclic coordinates. Periodic motion, small oscillations, normal modes. Special theory of relativity, Loretz transformations, relativistic kinematics and mass-energy equivalence.

III. Electromagnetic Theory:

Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems; Magnetostatics: 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, Refraction and Polarization, Fresnel's law, interference, coherence and diffraction. Lorentz invariance of Maxwell's equations, Dynamics of charged particles in static and uniform electromagnetic fields. Radiation from moving charges, dipoles and retarded potentials.

IV. Quantum Mechanics:

Wave particle duality, Schrodinger equation: time dependent and time independent. Wave functions in coordinate and momentum representations, Eigenvalue problems: particle in a box, harmonic oscillator etc.; Tunneling through a barrier. Wave function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Matrix representation, Dirac notation and state vectors. Motion in central potential: orbital angular momentum, angular momentum algebra, Spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules, semi-classical theory of radiation; Elementary theory of scattering, phase shift, partial waves, Born approximation, Identical particles, Pauli exclusion principle, Spin-statistics connection. Relativistic quantum mechanics: Klein Gordon and Dirac Equations.

v. Thermodynamics and Statistical Physics:

Laws of thermodynamics and their consequences. Thermodynamic potential, Maxwell relations, Chemical potential, phase equilibria. Phase space, micro and macro states, Micro-canonical, Canonical and Grand canonical ensembles and Partition functions. Free energy and its connection with thermodynamic quantities. First and second order phase transitions, Classical and quantum statistics. Ideal Bose and Fermi Gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law; Bose-Einstein

condensation.

VI. Electronics:

Semiconductor devices (diodes, junctions, traosistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, frequency dependence and applications. Opto-electronic devices (solar cells, photo-detectors, LEDs). Operational amplifiers and their applications. Digital techniques and applications (logic circuits, registers, counters and comparators). A/D and D/A convertors, Microprocessor microcontroller basics. Fundamentals of communication electronics, modulation techniques.

VII. Atomic & Molecular Physics:

Quantum state of an electron in an atom. Electron spin, Spectrum of Hydrogen, helium and alkali atoms. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS and JJ couplings. Zeeman, Paschen-Bach and Stark effects. Electron spin resonance, Nuclear magnetic resonance, Electronic, rotational, vibrational and Raman spectra of diatomic molecules, Frank-Condon principle and selection rules. Spontaneous and stimulated emission, Einstein A&B coefficients; Lasers, Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.

VIII. Condensed Matter Physics:

Bravais lattices. Reciprocal lattice. Diffraction and 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. Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasicrystals.

IX. Nuclear and Particle Physics:

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 asymmetry of nuclear forces. Isospin; 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. Classification of fundamental forces; Elementary particles (quarks, baryons, mesons, leptons); C, P and T invariance and applications of symmetry arguments to particle reactions, parity non-conservation in weak interaction; Relativistic kinematics.

23. TEXTILE TECHNOLOGY

I. INTRODUCTION TO FIBRES, MANUFACTURED FIBRES YARN FORMATION ,POST SPINNING, ADVANCED YARN FORMATION

1. **Introduction to Textile fibres:** Textile elements defined, Textile Institute Classification of Textile fibres ,Physical and Chemical Properties of fibres, Classification of Count systems , Universal Yarn Numbering system, Conversion from one system to other and within the system. Classification of Unconventional Natural fibres

2. **Techno- Economical information of Natural fibres :** Cotton, Wool, Silk, Jute, Flax and Linen fibres ; Varieties of these fibres , properties and applications . Special feature of Wool (Heat of Wetting , DFE, Bilateral structure, Felting) , Developments in Cotton (Chemically modified, Bt, Coloured , Never dried)

a) Classification of Unconventional Natural fibres : Role of fibres like Asbestos, Basalt , Coir, Maize, in Technical Textiles

b) Introduction to Silk Technology : Life cycle of Silkworm, Types of crops in Silk growing , Various operations and their significance in Silk Technology, Classification of Silk yarns and Silk yarn testing .

c) Jute Technology: Flow chart of Jute fibre to yarn, Machines and technical parameters

3. Technology of Manufactured Fibres : Classification of Manufactured fibres, Unique properties , Principles of Man made fibre spinning , Basic aspects of process and machine elements, Substrate and Geometry of Manmade fibres , forms of production of Manufactured fibres, Batch and merge number, Surface modification of fibres, *Spin finishes for fibres:* Need , methods of application , removal and estimation *Manufacture of Manmade fibres:* Raw materials, Flow chart , properties and applications.

II. YARN FORMATION PROCESS (SPINNING)

i) Pre- Ginning & Ginning : Modern Cotton pickers , Ginning percentage and Modern Gins for Indian Cotton ,Contamination in Cotton bales, Bale formation , Bale management , Selection of Cotton , Application of LPP Blending systems in Spinning, Mixing and Ideal Mixing and IBI , Modern Mixing vessels ,selection of openers , Degree of Opening and Cleaning ,Individual and Overall Cleaning efficiency , Bye pass , Selection of Spinning machines for low ,medium and finer grades of Cotton, Fibre fracture , processing of 100 % synthetics and Blends . Chute feed systems and Autolevellers at Blow Room .

ii) Carding : Concept , elements and setting for Cotton , Synthetics and Blends, Snap and Nep study , Wrapping check , Modern Cards , Waste extraction at Cards, Autolevelling at Cards. Production problems

iii) Drawframe : Objectives, concept of Real and Ideal Draft, Drafting elements, drafting systems, types of Creels, selection of Pre- Drawing and Post —Drawing process. Treatment of Cotton, Synthetic and Blends, Modern Draw frames ,Quality Control checks., Role of Break draft on Drawn sliver quality, Production problems .

iv) Combing : Need, Degrees of Combing, Preparatory process to Combing and Rait-of Pre-Comb Draft and selection of Comber preparatory machines, 5-min test at \\ Comber, Waste extraction study, Head wise and Overall waste at Comber, Modern Comber and their elements .Production problems

v) Simplex : Objectives, Principles , Drafting systems and elements, Breakage study, Role of Break draft on Roving ,Modem developments ,Production problems.

vi) Ring Spinning : Objectives, Principles , Drafting systems and elements, Breakage study, Idle Spindle study, Snap study, Count Control, imperfections , types of Builds and Hank meter gain and Loss ,Twist contraction , Snap efficiency , Bonda waste, Arrangements for doffing and donning , Number of doffer boys, Migration of fibres , Spinning Triangle, Role of Break draft on Roving ,Modern developments ,Production problems. Types of twists and selection of twist level

vii) Post Spinning Process: Selection of Process, Types , Bundling , Baling and pressing , Concept of Average and Resultant Count. Hank Yarn Obligation , Spin plan for Cotton, blends and Synthetics. Production of Sewing thread .

viii) Advanced Yarn Formation : Limitations of Ring Spinning, Principle of Open-End Spinning, types, selection criterion, Effect of trash in Draw frame on Open end yarn quality, Working principle of Rotor , Friction, Airjet , Airjet- Ring spun , Air Vortex and Wrap technologies and applications of all these yarns .

Yarn Texturising : Need, Principles, Methods and Selection of methods , Testing of Textured yarn, Special care for weaving of Textured yarn.

II. FABRIC FORMATION (WEAVING)

i).Introduction to Weaving preparatory machines : Need , imperfections in Ring Yarns, Systems of Yarn preparation and selection of a system ,Principles of Winding and their selection, Classification of winding machines, elements of winding machine (Rotoconer and Autoconer) Optimum Yarn Clearing and Yarn Tensioning , Role of Electronic Yarn Clearers, Production problems , Material handling , Quality control studies.

ii). Introduction to Pirn winding : Principles, Selection , Elements of Pirn, working of Semi, Automatic and Fully Automatic Pirn winders, Quality control studies , production problems . Significance of spindle direction in relation to Yarn twist.

iii). iii)..Introduction to Warping : Principles, elements of Warping machine , Types of Creels and their performance and selection . Quality control study and material handling . Arrangements for selvedge ends on Warper beams .Construction of Warper beams and their specification. Defects in Warping , Production problems

iv) Introduction to Sizing : Need, forms and Degrees of Sizing , methods of Sizing, Working of Hank, Ball and Tape warp sizing machines, Various zones in Multi-cylinder sizing machine , Selection of size receipe and size add on and pickup calculation , Back beam creeling , wet pick up control, distribution of size and steam to cylinders, Size preparation (selection of ingredients , concentration calculation, working of cookers and storage devices , Modern approach to size receipe and pickup) , working of various types of controls , Beam winding mechanism, arrangement to made for doffing and donning of sized beams, Beam press rollers and Mechanisms, Beam storage , After waxing , Cutmark motions ,modern developments and production problems .

Introduction to Post Sizing operations: Need, Types , working of semi and automatic machines, drawing calculations, selection of heald wire , drop wire and Reed

v)Loom Gaiting and Loom operations and Mechanisms : Types of gaiting , loom classification and specification, loom shafts and calculation of speeds in relation to picks per repeat, working principles of Tappet , Dobby and Jacquard Shedding mechanisms, Detailed working of Primary and Secondary motions. Modern developments, Loom timing for these mechanisms , defects of these motions. Quality control studies . Loom makes of India , Reed selection and Reed parameters, concept of Beatup and mechanics of Primary and Secondary motions. Construction of shedding tappets. Fabric defects.

vi) Introduction to Automatic weaving : Principle , need , concept of reserve on pirn, Weft feeler and Cop transfer mechanisms, transfer failure , Quality control aspects , Material handling in entire weaving preparatory and weaving sheds and their selection. Defects in Automatic looms.

vii) Introduction to Shuttless Weaving : Need , draw backs of Shuttle loom, Principles of modern methods of weft insertion, selection , working principles , settings and Primary and Secondary motions on these looms , Yarn preparatory requirements, Techno-Economics of Modern weaving , makes of Shuttless machines , Modern batching systems, Role of Cyclops

viii) Introduction to Dobby and Jacquard Shedding : Machines , types , classification ,working elements and material of construction and functions. Numerical problems . Selection of picks and Reed for different sorts on Dobby and Jacquard. Process of transfer of design on to lags and cards. Modern Positive Dobby and E- Jacquard. Casting out in Jacquards- Numerical examples.

ix) Weft Patterning motions: Need , types , conventional and modern , setting for a specific pattern in Conventional and modern looms. Defects and remedies

x). Introduction to Knitting (Warp and Weft Knitting): Terminology, Classification, machines, representation of structures , properties . Knit fabric defects, Knit Geometry, Knitting Dynamics, Knit patterning. Modern Developments , Prodtiction problems

xi). Introduction to Nonwovens: Need, terminology, Classification, Methods of manufacture as per Reverse Engineering , Testing and machinery. Modern developments, SMS, Industrial applications

xii). Introduction to Fabric Structure : fabric notation, role of interlacement diagrams, classification of weaves, Linear and Non —Linear relations of elements of fabric structure, modification of plain ,twill and sateen weaves. Loom arrangements for these modifications. construction and development of primary , secondary and fancy weaves in single and multilayered structure- Card cutting instructions for advanced fabrics —Yarn preparatory requirements and beaming and drafting arrangements- construction and production of complex weaves like Damask, Brochade, Figured terry , Backed , Double , Treble cloths. Arrangements of motifs on different basis .Colour and weave effects. Ornamentation of weaves and fabrics.

3

III. <u>TEXTILE WET PROCESSING</u>

i). Fundamentals of Textile Chemistry : structure and bonds , molecular arrangement, flowchart for production of finished fabric from grey fabric.

Introduction to Desising (methods, evaluation) , Scouring (methods, pralerns f evaluation), Bleaching (Need , degree of Bleaching methods , evaluation), Mercerisation (Need, methods and evaluation)- Quality Control aspects in preparatory process to wet processing .

ii). Introduction to Dyeing : Need , Colour and Constitution of Dyes, Classification of Dyes, dye uptake, elements of dyeing, principles of Dyeing . Industrial practices of Dyeing of Cotton , Synthetics and Blends

iii). Introduction to Printing & Finishing : Need , concept of Printing , Print fixation, Printing styles and methods of Printing , Print paste selection and Rheology-Printing defects and their

remedies finishing and various of types of finishes for fabrics. and their evaluation . Fabric folding and packing.

IV. <u>TEXTILE TESTING ,QUALITY ASSURANCE ,MILL MANAGEMENT & TEXTILE INDUSTRY</u>

i). Introduction to Statistical Quality Control: Need, methods of Sampling, Sample size determination with CV%, Sampling errors, Frequency and Weight distributions, Significance testing and ANOVA, Design of Experiments and Control Charts.

ii). Introduction Textile Testing & Quality Assurance : Need, Standard Testing conditions, fibre , yarn and fabric sampling , measurement and interpretation of fibre length, fibre fineness, maturity, strength, elongation, working principles of AFIS, HVI. measurement of fabric properties, Subjective Vs Objective properties, Interpretation of fabric properties and effect on fabric low stress mechanical properties interms of geometrical properties and treatment conditions. Effect of process parameters of Textile production like Spinning, weaving and Wet processing on fabric properties. Reverse Engineering and fabric designing . Role of KES-F, KES-Y and FAST methods of testing and interpretation. Correlation and Regression between properties of fibre, yarn and fabric .

iii) . QUALITY STANDARDS FOR TEXTILES : Role of ISO, SAS, ASTM, DIN, AATCC, BS, and their utility.

iv). Industrial Climatology, Mill Management & Textile Industry : Selection of suitable location, Layout, Maintenance programme, Concept and implementation of Safety , Work study and determination of Standard Time , Machine interference, Plant lighting , Ventilation , RH% and Humidification systems, types and levels of Management, functions, Authority and Delegation , Decision making process, Control process, MBO, Concept of **Quality Circles and Six Sigma. Concept of Lean production , Implementation of Lean and Six Sigma.** Brief note on various types of concepts like Cost sheet, process costing , Financial statements and Management , Inventory control and ABC analysis.

V. **ROLE OF GOVT. OF INDIA IN PROMOTION OF TEXTILE AND ITS ALLIED ACTIVITIES :** Role of Ministry of Textiles. Various branches of MOT, TMTT, TMC, 16- Technical Textiles as defined by MOT.

VI. **TECHNICAL TEXTILES:** Textiles in Aerospace, Dairy, Agriculture, Horticulture, Medical, Manufacturing fields,Protec, Buildtech, Automobile ,Geotextiles, Filtration .