

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

Post Code Nos. 15 to 17

<u>PART-A:</u> Written (Objective Type) Examination:				
Paper-1	General Studies	150 Marks.	150 Qns.	150 Minutes
Paper-2	Concerned Subject	300 Marks.	150 Qns.	150 Minutes
<u>PART-B:</u> ORAL TEST (Interview)		50 Marks		

- N.B:**
1. The paper in concerned subject for Engineering streams is of Engineering Bachelor's degree standard.
 2. The Question papers will be in English only.

Subject Code	Subject
15	Footwear Technology
16	Sugar Technology
17	Physics

SYLLABUS

GENERAL STUDIES

01. **SCIENCE AND TECHNOLOGY:**

- a) General Science and Technology.
- b) Role and impact of science and Technology on India's development.

(Questions will cover general appreciation and understanding of matters of everyday observation and experience as may be expected of a well-educated person who has not made a special study of science and technology disciplines).

02. **INDIAN HISTORY AND CULTURE:**

- a) Modern Indian History from 19th century to the present.
- b) Nationalist Movement and Constitutional development.
- c) Indian Culture and Heritage including architecture, Fine Arts, Dance Forms, Music, Paintings, Folk Arts and performing arts.
- d) History of Andhradesa Society, Culture, Geography and Economic Development.

03. **INDIAN POLITY:**

General and broad understanding of the structural (institutions) and functional (processes) aspects of Indian Political System.

04. **INDIAN ECONOMY AND GEOGRAPHY OF INDIA:**

- a) Structure of National Economy.
- b) Economic Development (including planning) since independence.
- c) Economic Reforms.
- d) Physical, Economic and Social Geography of India.

05. **CURRENT EVENTS:**

Current Events of Regional, National and International importance.

06. General Mental Ability (reasoning and analytical abilities)

FOOT WEAR TECHNOLOGY

01. Classification of foot wear, leather goods, Garments based on construction, utilization, style, function of foot wear comparison of leather articles and footwear with that are made of non leather.
02. Bones, Joints, Arches of foot – Development of foot types of feet – Abnormalities of foot – Reasons for foot problems – Deformed feet – Remedy.
03. Foot care – Foot comfort – Parameters for foot comfort – perspiration's – vapour permeability – pressure points in foot wear – shock absorption's – Physical and mechanical properties like stress and strain. Thermal and electrical conductivity – Friction and pressibility.
04. Measurements – Foot drafting – draft length and girth – foot wear scales of different system – conversion from one system to other system.
05. Foot wear functions – Foot and footwear relations shoes boot- parts of shoe and foot wear – Last – Parts of lasts Function of last-Relation between last, shoe and foot leathers garments, sizes leather goods sizes – component – uses.
06. Tools used in manufactures of foot wear, leather goods – leather garments – their sizes – Maintenance – uses of tools last sizes – makes – types of lasts, materials – used for making lasts.
07. Designing – Purpose of designing – Basic rules of designing – Designing of foot wear – leather goods – garment, mean form cutting – types of mean form preparation – development of standard and working patterns for foot wear components.
Grading – different grading systems – equipment used for grading.
Designing of leather goods – Garments for different uses – sizes – components.
Computer – utility in designing CAD – Auto CAD package for designing component of foot wear, leather goods and garment.
08. Knowledge of leather making – various operations involved in making leather. Classification of leather based on Raw material – types of tanning – type of finish – knowledge of defects in leather. Selection of leather for different use.
09. Properties of leather – Physical properties like tensile strength - % elongation at break stitch tear, tongue tear strength – water absorption – vapour permeability – grain crack and grain bursting resistance, flexibility – abrasion resistance – their testing methods – importance.
Adhesives – stability – bond capacity, abrasion resistance of sole materials.
10. Materials: Details of various materials used in leather goods, footwear and garments manufacture like leather – adhesive threads, lining materials – fabrics polemeries. Metrallic fittings – Zips – toe caps, stiffness heel plate, toe plates leather boards, paper boards, soles, plastics – thermo plastic – their preparation – proper ties – use in manufacture of leather articles, foot wear.
11. Finish materials – uses of various finish materials like heel balls – polish – ware creams – resin – rosin shellac – plastisize – binder – their uses.
12. Seams – different types of seam utility – tools, machines used – working principal of various stitching machines – fixing of various fittings. Machines used, their working principle, specifications – tools used.
13. Clicking – Machines used – their working system – hand clicking tools used – A skiving – machines used – hand skiving –various types of lasting – machines used, their working system comparison of various systems – preparation of testing – sole – insole.
14. Bottom preparation, filling, selection of various materials.
Attachment of sole to upper – different methods of moulding –machines used, specification – working system.
15. Finish – various operations involved as finishing of foot wear. Material used – Machines used – cares.
16. Costing and quality control: - Costing footwear, leather goods, and garments by different system, quality – importance.

Manufacture of various types of leather goods various operations involved – manufacture of Garment
Selection of Raw materials – Method of making – costing.

BIO-MEDICAL ENGINEERING

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

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

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

Hearing Aids: Different Types, Comparison of Microphones, Receivers and Amplifiers.

Electro-Surgical Equipment.

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

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

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

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

Ultrasound Applications for Surgery: Lithotripsy, Principles and Applications.

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

Amplifiers for Bio-Medical applications: Differential, Carrier amplifiers, Phase sensitive detector for LVDT. Principles of wave generation and shaping. Recorders and play devices for Bio-Medical applications. General features of ink-jet, thermosensitive and optical recorders. General features of display devices for bio-signals. 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.

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

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

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

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.

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

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

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

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.

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

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

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

Defibrillators : D.C. Defibrillators of capacitive discharge and delay line capacitive 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 Heart : 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.

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. HodgkinHuxley formulation. Membrane conductance. Nerve conduction membrane properties from current voltage relations, models of squid axon. Propagation of impulses in unmyelinated and myelinated nerve fibre. Electrical properties of receptors. Generator potential of Receptors. Intensity-frequency relationship. Electrical properties of synaptic junctions - EPSP and IPSP.

Electrical Activity of the heart. Conduction system of the heart. Characteristics of Action potentials at SA node, Atria, AV Node, Purkinje fibres and ventricles, ECG complexes. The international standard 12 leads of ECG. Standard leads of Einthoven, precordial leads and augmented limb leads. Relationship between unipolar extremity leads and standard bipolar leads. Volume conductor fields : Bio-electric sources, Volume-

conductor formulation. Solid angle computation. Infinite cylindrical axon, core conductor model non-homogenous media, integral equations.

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

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

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

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

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

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

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

Equivalent circuit Properties.

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

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

Broad classification of Biomedical Instrumentation for Clinical practice that is:

1. Instrumentation for Diagnosis, ECG, EEG, EMG, PCG etc.,
2. Therapeutic Devices - Stimulators, diathermy equipments etc.,
3. Prosthetic Devices - Pacemakers, Artificial Organs.
4. 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, Spectrophotometer, Electrophoresis, Centrifuges, Waterbath etc., Hospital illumination, Theatre illumination, Requirements and typical arrangements. Miscellaneous equipment's.

ELECTRONICS AND INSTRUMENTATION ENGINEERING

01. **FUNDAMENTALS:** Coulomb's law – Ohms law – Faradays laws of electromagnetic induction, Kirchoff's laws, Ampere's law Resistance, Capacitance and Inductance.
02. **ELECTRONIC CIRCUITS:** Graph, tree and links – Loop currents, node voltages two port networks, Z, Y and Hybrid parameters. Alternating currents, RMS value, form factor, R.L.C. in AC Circuits power; and power factor, network theorems – Harmonic analysis.
03. **ELECTRONIC CIRCUITS:** Logic circuits – Universal gates Booleans functions and their realisation – Product of sums and sums of product forms – Combinational circuits – Sequential circuits, SR & JK flip flops, Series and parallel Counters Registers.
04. **ELECTRICAL MEASUREMENTS:** Indicating instruments, D1 Arsonval type Galvanometer, Vibration Galvanometer, Ballistic Galvanometer, Measurement of resistance, DC & AC Potentiometers, Wheatstone Bridge, Kelvin's bridge, AC Bridges, Maxwell's, Anderson, Heaviside and Schering bridges.
05. **ELECTRONIC INSTRUMENTS:** Cathode Ray Oscilloscope and its applications, Electronic Voltmeters – Balanced bridge type, transistor Voltmeter, Chopper amplifier type Voltmeter, High Frequency measurements.
06. **INSTRUMENTATION:** Transducers – Primary and Secondary – Classification of transducers, Potentiometers as displacement transducers, strain gauges, Induction and capacitive transducers, LVDT, Rotary variable differential transformer, Piezo electric transducer, Digital Voltmeters, Digital frequency meters, measurement of displacement, strain gauge circuits, measurement of pressure, Measurement of Velocity, measurement of temperature and measurement of flow.

PLASTIC & POLYMERS

I. CHEMICAL ENGINEERING:

1. Fluid Mechanics : Dimensional analysis, fluid statics, fluid flow phenomena, basic equations of fluid flow, flow of incompressible fluids in pipes – Friction factor, Hazen-Poiseuille equation. Turbulent flow, Transportation and metering of fluids. Calculation of pump power for transportation of fluids, flow meters – orifice, Venturi and Rotameters.

2. Head Transfer : Conduction in solids – Steady state and unsteady state. Heat flow in fluids – overall heat transfer coefficient, Log-mean temperature difference, calculation of individual heat transfer coefficient and overall heat transfer coefficient. Fouling factors, Heat transfer to fluids without phase change – Thermal boundary layer, heat transfer by forced convection in laminar flow and in turbulent flow, empirical equations; Heat transfer from condensing vapors. Heat exchange equipment – Double pipe heat exchangers and evaporators.

3. Mass Transfer : Molecular diffusion in fluids, mass transfer coefficients, Distillation (binary system), gas absorption, drying and liquid extraction operations.

4. Reaction Engineering : Rate of reaction, variables affecting the rate of reaction. Interpretation of kinetic data in batch and flow systems. Theories of reaction rate, classification of reactors, design equations for batch and flow reactors.

5. Thermodynamics : First law of thermodynamics – Internal energy, Enthalpy, heat capacity, first law for open systems. Second law of thermodynamics – statement, entropy function, calculations of entropy changes. Free energy functions. Calculation of enthalpy and entropy as function of pressure and temperature, Heat effects. Criteria for equilibrium and their application.

6. Mechanical Operations : Size reduction, Properties, Handling and Mixing of particulate solids, Mechanical separations, Screening Filtration, Sedimentation, Conveying and Storage of solids.

7. Process Technology : Manufacture of following chemical products in process industries – Location and uses – Water, Soda ash, Caustic soda and Chlorine, Ammonia, Fertilizers – Industrial acids, Sulphuric acid, Nitric acid, Phosphoric acid – Industrial gases – Sugar, Pulp and paper, Cement, Electro thermal industries; Calcium carbide, Silicon carbide, Graphite, Coal chemicals, Pigments and Paints.

8. Material and Energy Balances : Basic calculations, Material balances with and without chemical reactions, energy balances, combustion.

9. Instrumentation and Process Control : Qualities of measurement, measurement of temperature, pressure and vacuum, liquid level, density and viscosity, composition and analysis. Process control – Automatic process control – Elements of a control system – Controllers modes of control and its applications.

II. ELECTIVE/SPECIALIZATION : PLASTIC AND POLYMERS

Introduction – Definition of Polymers, Classification of polymers, Functionality, Polymerization mechanisms – Chain polymerization (Free radical, anionic, cationic and coordination polymerization – Ziegler Natta catalyst), step polymerization (polycondensation, poly addition reactions).

Molecular weights of polymers and their determination methods – Number average molecular weight, Weight average molecular weight, Weight and viscosity average molecular weight. Methods of determination – Cryoscopy, Ebulliometry, Light scattering and Viscometric methods.

Polymerization processes : Bulk polymerization, Solution polymerization, Suspension polymerization and Emulsion polymerization.

Fabrication processes : Injection moulding, Extrusion, Blow extrusion and extrusion blow molding.

Manufacturing Methods of a few common Polymers : LDPE, HDPE, Polystyrene, Polyvinyl chloride, Phenolic resins.

Status of Indian Plastics – Industry with respect to production, location of industries, demand etc.

MINING ENGINEERING

1. **GEOLOGY:** Structural Geology: Definition and scope. Recognition of faults, folds, joints, unconformities etc., Primary and induced structures, their importance in Mining, Bedding, Lamination, foliation, fracture, Cleat etc., field Geology; importance and scope of field Geology, field techniques, geological mapping. Use of survey equipment.
2. Principles of Stratigraphy.
3. **EXPLORATORY DRILLING:** Principles, selection of site, lay outs, details of equipment, methods of drilling and their variation, interpretation of bore hole data.
4. **EXPLOSIVES AND BLASTING:** Classification, types and use of explosives storage and transport. Blasting techniques in UG and open cast mines.
5. **SUPPORTS:** Objectives, limitations of mine supports, Types of mine supports and systematic timbering.
6. **OPENING AND CHOICE OF MINING METHODS:** Opening, development of mineral deposits, classification of mining methods, merits, demerits and application. Bord and pillar mining. Long wall mining. Open cast mining and their variations. Design of suitable methodology of mining for specific conditions like thickness, depth, inclination, annual production etc.,
7. **METAL MINING:** Scope and limitations of U/G mining methods, Classification of U/G metal mining systems and their applications in different conditions.
8. **MINE SURVEYING:** Principles of surveying. Different methods and their importance. Chain surveying. Compass surveying, theodolite surveying, plane tabling, levelling, triangulation, correlation. Astronomical terms and definitions. Mine plans and sections. Regulations pertaining to plans and sections.
9. **MINING MACHINERY:** Elements of transport system, classification and techno economic indices. Rope haulage, locomotive haulage, conveyers, Aerial rope ways, trackless haulage, Winding. Drainage and pumping.
10. **MINE ENVIRONMENTAL ENGINEERING:** Mine air and environment. Natural and mechanical ventilation, Types, design variables, selection, installation and maintenance. Mine fires, explosions and inundations, Rescue and recovery.
11. **MINE LEGISLATION AND SAFETY:** Regulations pertaining to conservation's, exploitation of mineral deposits. Safety welfare and hygiene of mine workers.

Sd/- Secretary
16/04/2007

CIVIL ENGINEERING

01. ANALYSIS OF STRUCTURES:

Sending stresses and shear stresses in beams;

Deflection and slope of beams;

Combined bending and direct stresses; axially and eccentrically loaded columns;

Close-Coiled and open-coiled; helical springs under axial load and axial twist; carriage springs;

Analysis thin and thick cylinders; compound cylinders;

Analysis of statically determinate plane trusses; method of joints and method of sections.

Analysis of statically indeterminate beams; proposed canti-levers, fixed beams and continuous beams.

Strain energy method, slope-deflection method, moment distribution method and Kaini's method of analysis of indeterminate structures.

Influence lines and moving loads on beams and simple bridge trusses.

02. STRUCTURAL DESIGN:

Reinforced concrete, concrete technology, R.C.C. Design, working stress method and limit state method, Design of beams, Design of one-way and two-way slabs, design of axially loaded columns, 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 revetted and welded joints, design of tension members; Compression members, simple and compound beams. Design of plate girders, crane girders and roof-trusses. Elements of pre-stressed concrete.

03. FLUID MECHANICS AND HYDRAULIC MACHINES:

Fluid properties; fluid static's; fluid-flow concepts; Laminar and turbulent flow; steady and unsteady-flow, uniform and non-uniform flow; Fundamental EQUATIONS; CONTINUITY EQUATION; Euler's equation of motion; Bernoulli's equation, Analysis of liquid jets; flow through orifices and mouth pieces; radial flow, flow along a curved path; Momentum equation and applications; Moment of Momentum equation. Dimensional analysis and similitude; Viscous flow-laminar flow through circular pipes; velocity distribution in laminar flow. Turbulent flow in pipes, velocity distribution in turbulent flow; Flow measurement – pressure moment, velocity measurement and discharge measurement, venturimeter, Orifice, meter, notches and weirs. Hydraulic machines; Turbines and pumps; basic equations; Orifice, performance, selection, specific speed.

04. WATER RESOURCES ENGINEERING:

Steady flow through open channels. Uniform flow in channels; Chezy 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. Stream gauging; flood-Studies, Hydrograph and unit hydrograph, flood routing. Ground water resources, Darcy's law, Dupuits equation, yield of wells, recuperation test.

05. 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, Aerial photogrammetry and photo interpretation, remote sensing and electromagnetic distance measurement.

06. GEO-TECHNICAL ENGINEERING:

Physical properties of soils; identification and classification of soils; permeability and seepage; consolidation; shearing strength of soil; stability of earth slopes; site investigation and sub soil exploration.

Stress distribution in soil; soil; compaction; lateral earth pressure and retaining walls; bearing capacity and shallow foundations; pile foundations; well foundations; Machine foundations.

07. 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., bitumenous and concrete roads; highway drainage.

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

08 ENVIRONMENTAL ENGINEERING:

Water supply engineering; sources of water supply, conveyance of water, distribution systems; quality of water; treatment of water; filtration; dis-infection; methods of water treatment.

Sanitary engineering; sewerage and sewage disposal; house fittings; design of sewers; characteristics of sewage, primary and secondary treatment of sewage' methods of disposal of sewage.

ELECTRICAL AND ELECTRONICS ENGINEERING

01. ELECTRIC CIRCUITS, FIELDS & MEASUREMENTS:

Network elements – Ohm's law and Kirchoff's laws – formation of mesh and nodal equations – topological description of networks – response of R, L and C elements to arbitrary excitations – Laplace transform method of analysing networks.

Network theorems – superposition, Thevenin's Norton's theorems – Maximum power transfer thereciprocity theorem – applications – two port parameters – Z, Y, ABCD, H para meters – their relationships.

A.C. Circuits – single phase circuits – J-notation – calculations – resonance – Polyphase – circuits – measurements of polyphase power.

Electromagnetic theory – general relations in static fields – potential gradient and field intensity – flux density – Gauss's law – Poisson and Laplace equations – relations in electromagnetic fields – ampere's law – flux and flux density – divergence and curl – vector magnetic potential.

Electrical measurements – Types of measuring instruments – Principles of operation – extension of ranges – instrument transformers.

02. CONTROL SYSTEMS, COMPUTATION AND ELECTRONICS

Control systems – Types of servo mechanisms – equations and models of linear systems – block diagrams – time response of second order systems – stability criteria – root locus technique – frequency response – Nyquist criterion – Bode plots.

Elements of computation: Digital systems – flow charts and algorithms – FORTRAN – types of statements – logical expressions – Assignment statements – program structure – Scientific and Engineering applications.

Electronics: Solid-state devices and circuits – small signal amplifier design – feedback amplifiers – Oscillators – FETS – Thyristors.

03. ELECTRICAL MACHINES:

Principles of Electromechanical Energy Conversion: Basic ideas of production of torque – concepts of generation of voltages – formulae for voltage and torque production.

Three phase induction motors: The revolving field theory – Principles of operation of induction motor – torque equation – Computation of performance – torque speed characteristics – motor starters – conventional and thyristor controllers for speed control of induction motors.

Single phase motors: Revolving field theory – types of single-phase motors – equivalent circuits – speed control – applications.

Synchronous machines: Generation of 3-phase voltages – types of synchronous machines – equivalent circuit – experimental determination of reactances – voltage regulation and efficiency – parallel operation – transient and subtransient reactances – synchronous motors – theory of operation - -phase of diagram – equivalent circuit – performance and power factor control – applications.

Special machines: Two phase servomotors – stepper motors – methods of operation – metadyne and amplidyne – operating characteristics and applications.

D.C. Machines and Transformers.

04. POWER SYSTEMS:

Generation: Methods of power generation – steam, hydro, nuclear, diesel – selection of site for each – general layout of each type – function of each component – economics of different types – base and peak load stations – pumped stations – simple calculations in hydro station design.

Transmission: A.C. Vs. D.C. transmission – criteria for selection of voltages – transmission line parameters – G.M.D. and G.M.R – concepts for short, medium and long lines – line calculations – A.B.C and D constance – load flow analysis – surge impedance loading.

Corona and insulators: production of corona – disruptive and visual corona – corona loss – methods to avoid corona – types of insulators – string efficiency.

Fault analysis: Per unit representation: fault analysis – Symmetrical and unsymmetrical faults – application of symmetrical components – reactors.

Protection: Switch gear – methods of arc extinction – classification of circuit breakers – definitions – calculations in switch gear – testing of circuit breakers – Relaying principles – primary and back up relaying – definitions – operation of different types of relays – applications to line, transformer and generator protection – protection of lines and equipment against voltage surges – travelling wave theory.

Utilisation: Industrial drives – motors for various applications – braking – methods of heating and welding – welding transformer – Economics and other aspects of track electrification.

MECHANICAL ENGINEERING

01. FLUID MECHANICS:

Fluid Properties, fluid static's, Kinematics and Dynamics, Euler's equation, Bernoulli's energy equation, flow of ideal fluids, Viscous incompressible flows – laminar flow, boundary layer, basic features of turbulent flow, flow through pipes, fluid machinery, Specific speed and classification of fluid machines. Performance and operation of pumps, impulse and reaction turbines, velocity triangles and degree of reaction.

02. THERMO DYNAMICS:

Thermo dynamic systems, measurements of temperature work, heat and internal energy. First law of thermodynamics, ideal gas equation Air standard cycles, Carnot, Otto, Diesel, dual and Joule cycle. Energy and Enthalpy. Second law of Thermo dynamics. Available and Unavailable energies. Reversible and irreversible processes. Psychrometry, Properties of pure substances.

03. MATERIAL SCIENCE:

Structure of metal and alloys, Bonding in solids. Imperfections of metals and in crystals, fracture, creep, fatigue and corrosion. Phase Rule, phase transformation diagrams and lever rule.

04. ENGINEERING MECHANICS AND STRENGTH OF MATERIALS:

Equivalent force systems, free body concepts and equations of equilibrium, frictional forces. Kinematics and dynamics of rigid bodies. Stress and strain, elastic limit, yield point and ultimate stress, shear force and bending moment diagrams for beams. Calculation of stress slope and deflection in beams, theories of failure, torsion of circular shaft, thin cylinders, equivalent bending moment for solid and hollow shafts.

05. MANUFACTURING PROCESSES:

Classification of manufacturing processes. Fundamentals of casting. Classification of casting process. Sandcasting – patterns, molding, melting and pouring solidification, cleaning and finishing casting defects. Metal forming – hot and cold working, forging, rolling extrusion, wire and tube drawing, deep drawing, blanking and stamping processes.

Fundamentals of welding arc and gas welding, brazing and soldering, heat treatment – annealing – normalizing, hardening and tempering.

06. APPLIED THERMO DYNAMICS:

Internal combustion engines classification, working and performance of C.I. and S.I. engines combustion process in I.C. Engines Rating of fuels, pre ignition and knocking in I.C. Engines, Carburation and injection, Reciprocating air compressors – Single and multi stage compressors, inter cooling, volumetric efficiency.

Rotary Compressors – fans blowers and compressors Axial and Centrifugal compressors – merits and demerits.

Boilers and condensers – types of boilers and condensers, calculation of boiler efficiency and equivalent evaporation, feed water heaters.

Steam and Gas turbines Impulse and reaction turbines degree of reaction velocity triangles, ranking cycle for steam turbine power plant reheating and regeneration Gas turbine cycles methods of improving gas turbine cycle efficiency.

07. HEAT TRANSFER AND REFRIGERATION:

Modes of heat transfer, one dimensional steady and unsteady heat conduction convective heat transfer forced convection over flat plates and tubes, free convection over cylinders and flat plates radiative heat transfer-black and grey surfaces. Types of heat exchangers – heat exchanger performance LMTD and NTU methods vapor compression cycle analysis. COP; and its estimation vapor absorption refrigeration cycle properties of refrigerators.

08. MACHINE DESIGN:

Design for static and dynamic loading fatigue strength stress concentration, factor of safety designing of bolted, riveted and welded joints, hydro dynamic lubrication, journal and roller bearings design of spur and helical gears, clutches and brakes. Belt and rope drives Design of shafts, keys and couplings.

09. THEORY OF MACHINES:

Constrained motion, plane mechanisms, velocity acceleration analysis, Flywheel and their applications, Balancing of reciprocating and rotating masses cams and followers, Tooth profiles Types of gears Principles of gyroscope, vibration of free and forced one degree of freedom systems with and without damping, critical speed of shaft.

10. PRODUCTION ENGINEERING:

Metal cutting and machining types of chips, chip formation tool wear and tool life, machine ability single point and multi point cutting operations machining processes shaping, planning, turning, milling, grinding, hobbling and drilling operating unconventional machining processes – USM, EDM, ECM and LBM. Basic features of NC Machines tools linear and angular measurements, Comparators, limit gauges, screw and gear measurements.

11. INDUSTRIAL ENGINEERING AND MANAGEMENT:

Industrial organisations and plant layout production planning and control cost of manufacturing. Break even analysis. Time and motion study, basic linear programming and queing theory. PERT / CPM in production systems.

ELECTRONICS & COMMUNICATION ENGINEERING

01. Network analysis, Topology, Tree Tieset out set, first and Second order Circuits. Steady State and Transient response, Sinusoidal steady State Analysis. Series and parallel Resonance, Network Theorems, Laplace Transforms, Fourier series, Fourier Transforms – Applications, Two port. Network Parameters, Interconnection of two ports, Image Impedance, Image Parameters. Filters – constant K and M derived sections. Electronics Devices – Diodes, Transistors, FET biasing, and characteristics, Frequency, Response, Amplifier circuits. Electro Magnetic Theory – Maxell's Equations. Coulomb's law, Amper's law , Faraday's law, Poynting Energy Theorem, Stoke's theorem, uniform plane waves. Transmission Line Theory – Standing waves & Travelling waves, Reflection, VSWR.

02. Feedback Amplifiers and oscillator Circuits Wave Shaping circuits, Logic Gates, Boolean Theorems, Adders & Subtractors. Antennas & Propagation – Radiation Principle, Antenna parameters. Definitions. Directional Antennas, Linear Antenna Arrays, Broadside & End fire Arrays, Gain, Directivity, Radiation pattern. Ground Wave, Sky Wave, Ionosphere Propagation, Guided Waves, Rectangular Wave-Guide Analysis, Microwave Circuits and Components. Microwave Tubes, Klystron, Magnetron, and TWT. Modulation Techniques – AM, FM, PM. Channel capacity, Noise, AM, FM, Transmitters, Radio Receivers. TV and Satellite Communication – Principles Radar Equation and Applications of Radar Computer Programming, FORTRAN, BASIC, PASCAL, Are Programming languages.

COMPUTER ENGINEERING

01. Logic families, gates, flip-flops, Multiplexers, decoders, registers, counters, adder circuits, Boolean algebra, Combinational circuit design, minimisation, sequential circuit design, number systems, inter conversion, number representation, computer organisation, instruction formats, addressing modes, micro-programming, ALU organisation, multiplication and division algorithms, memory hierarchy, cache and associate memories, virtual memory, memory IC's, I/O organisation schemes, interrupts, arbitration, DMA, IOP, micro processors, interfacing, pipeline, SIMD and MIMD organisations, proposition and predicate logic's, methods of deduction, set theory, relations, functions, algebraic structures, lattices, recursion, combinatorics, graph theory, representation, path matrix, warshall's algorithm, cyclic and bipartite graphs, planner graphs, Hamiltonian graph, chromatic number, trees, binary tree traversals, representation of expressions, spanning trees, breadth-first and depth-first algorithms, finite automation, pushdown automation, Turing machine, grammars, type 0, 1, 2, and 3, LL and LR grammars.

02. Algorithms, flow-charts, programming methodology, data structures, PASCAL, FORTRAN, COBAL and 'C' languages, theory of programming languages, file organisation, searching and sorting; methods, DBMS, database models, query languages, operating system, directory concept, processor scheduling, memory allocation, paging and segmentation, device management, deadlocks and prevention, concurrent processing. DOS and UNIX features, language processors, syntax and semantic analysis, code generation, optimisation, assemblers, loaders and linkers, algorithm design techniques, Computer networks, digital modulation techniques, modems, error detection and error correction, BISYNC and HDLC protocols, OSI model, network routing algorithms, LAN operation methods, Computer graphics, DDA algorithms, graphic primitives, 2-D transformations, graphic input devices, software engineering development life-cycle, system analysis, modular design, testing and validation, CASE tools, AI techniques, natural language understanding, learning, knowledge representation, expert systems, LISP, PROLOG.

AUTOMOBILE ENGINEERING

01. 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.
02. Heat Transfer: Conduction Convection – Thermal Radiation – Heat Exchangers.
03. 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.
04. Instrumentation: Transducers – Flow measuring transducers – Temperature measurement – Strain gauges – Mechanical measuring devices – Slip gauges – Plug gauge – Micrometers in bars optical flat etc.
05. Automobile chassis & Systems: Chassis 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.
06. 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.
07. Kinematics of Machines: Kinematics – Velocity and Acceleration – Properties of instantaneous centre – Gears – Gears trains – Oams – Governors – Brakes and dynamometers – Clutches – Power transmission – Chain drives.
08. 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.
09. 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.

TEXTILE TECHNOLOGY

- I.
1. Introduction of Textile Fibres, their general properties physical and chemical and classification of Textile Fibres. Microscopic view of fibres.
2. Application of cotton fibre and Raw material, cultivation of cotton, common diseases and plant protection methods. Important varieties.
3. Manmade fibres and their raw materials. Outline of production of synthetic fibres. Physical and chemical properties and microscopic view.

4. SPINNING:

- i) Methods of picking: manual and mechanical
- ii) Ginning: Objectives and methods
- iii) Mixing: Blending of different varieties, types of mixing, auto mixer, aeromixers.
- iv) Blow room line and various machines used in it. Concept of beating point and its use in spinning of different fibres.
- v) Lap defects and remedies
- vi) Calculations regarding better speeds, lap weight, hank of lap, drafts and production.

CARDING: Objectives and principles of carding, functioning of carding machine. Types of carding machine. Calculations regarding carding machine, lap sliver study, waste control in carding, Tandem cards, Auto leveler, card sliver, lap feed and chute feed systems.

DRAW FRAME: Objects, Principles and various machines used in drawing process. Functions of draw frame machines. Different types of Drafting systems, weighing systems, Roller settings and draft distribution. Calculations regarding draw frame. Study of lapping and lapping machines.

COMBER: Objects, principles and different types of combing machines and calculations there of.

SPEED FRAME: Principles, objects and functions of speed frame. Working of speed frame and calculation regarding speed frames.

RING FRAME: Principles, objects and functioning of Ring Frame machines working of Ring Frame and calculations regard ring frame. Traveller, rings and other important parts of ring spinning frame. Drafting systems. Yarn defects – causes and remedies. Calculations regarding spinning.

DOUBLING: Objects and types of doubling. Features and two for one twistors. Manufacturing of sewing thread. Calculations regarding production with reference to various parameters of spinning. Open end spinning: Types and methods of open end spinning.

TEXTILE CHEMISTRY: Coal tar distillation. Chemistry of sizing, Bleaching and dyeing. Various dyes and chemicals, types of printing and finishing machines and methods. Process of mercerising. Various dyes used in dyeing of different fibres.

Calculations regarding all processes mentioned above.

II. WEAVING:

- 1) Object of the preparatory process and types of warp preparation. Classification types of preparatory machines. Principle of warp winding process. Warp winding machines, Automatic warp winding machines. Pirn winding machines.
- 2) Sizing: Importance and objects of sizing. Requirements and application of size and preparation of size. Slasher sizing machines. Principles of modern size controls used in sizing machines. Study of the development in sizing.
- 3) Principles of weaving process. Basic requirements of weaving loom and types of looms. Study of handlooms and plain powerlooms. Working of the mechanisms faults and remedies with references to the powerloom weaving and cloth production.
- 4) Principles of Automatic and shuttleless weaving. Study of Modern Automatic looms viz., Dornier, Airjet, Waterjet, rapier, Grib pebloom.
- 5) Fabric Structure: Principles of fabric structures. Different types of weaves and their construction. Drafting and peg plans according to weaves, Double Cloth, Dobby and Jacquard designs.
- 6) Understanding Mill maintenance. Functions and utilizes. Maintenance and lubrication schedules in various departments.

- 7) Textile Testing: Sampling of various material viz., cotton, yarn, fabric etc., Physical and chemical testing of fabrics and other material. Defects of materials and their identification. ISO & TOM. Concepts and Application.
- 8) Textile industry and management – introduction, concepts mill management – production, material, financial, marketing management. Feasibility study and Industrial safety.
- 9) Calculations regarding all processing mentioned above.

ARCHITECTURAL ENGINEERING

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

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

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

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

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

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

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

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

Water supply and Sanitary Engineering: Sources of water supply, Quality of water, Treatment of water, Distribution system of water, Collection and Treatment of refuse, Sewage, Principles of drainage, plumbing and Sanitary fittings and fixtures, Roads & Pavements.

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

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

Building Services: Electrical Services, Lighting, Air Conditioning, Elevators and Escalators, Telephones and EPABX, Security systems, Fire fighting systems, Swimming pools, Energy sources of building: wind energy, photo voltaic, Bio-mass, Waste Disposal: Industries & Hospitals, Hotel services and Elevated flooring.

Sociology of Human settlements: Sociological aspects, Elements of society, Urbanization, Historic Evolution, Transportation and communication, Principles of ekistics.

Economics, Estimating and Costing: Introduction on economics, Micro and Macroeconomics, economic issues, Financing of a project, Quantity surveying and estimating (approximate and detailed) and rate analysis.

Town Planning: Town forms in urban planning and development processes, various levels of planning: national, regional, urban, rural, local etc., objectives of town planning, O-D surveys, F.S.I. planning of industrial and recreational areas, urban renewals, TCPO and Town planning organization in India.

Building Acoustics: Need to study acoustics, history of acoustics, generation, propagation, transmission of sound, characteristics of sound, sensibility of human ear, resonance, reverberation time, sabine's formula, echoes, principles of acoustical design process and sound isolation.

Advances Construction: Decay and Damage, Building Failures, Maintenance and Renovation, Guniting, Strutting, Underpinning, Grouting, Propping, Effect of ageing, Weathering.

Professional Practice: Types of offices for practice, COA registration and rules, IIA Code professional conduct, architects duties, principles of Indian contract act, Tenders, Contracts, Easements, Arbitration, Valuation, Role of Consultants, Building Bye-laws, National Building Code, Consumer protection act, transfer of property.

Computer Applications: Hardware and Software requirements, Operating systems, Features of presentation package, drafting packages and benefits of Internet technology.

CHEMICAL ENGINEERING (PETRO-CHEMICALS)

I. CHEMICAL ENGINEERING:

1. Fluid Mechanics : Dimensional analysis, fluid statics, fluid flow phenomena, basic equations of fluid flow, flow of incompressible fluids in pipes – Friction factor, Hazen-Poiseuille equation. Turbulent flow, Transportation and metering of fluids. Calculation of pump power for transportation of fluids, flow meters – orifice, Venturi and Rotameters.

2. Heat Transfer : Conduction in solids – Steady state and unsteady state. Heat flow in fluids – overall heat transfer coefficient, Log-mean temperature difference, calculation of individual heat transfer coefficient and overall heat transfer coefficient. Fouling factors, Heat transfer to fluids without phase change – Thermal boundary layer, heat transfer by forced convection in laminar flow and in turbulent flow, empirical equations; Heat transfer from condensing vapors. Heat exchange equipment – Double pipe heat exchangers and evaporators.

3. Mass Transfer : Molecular diffusion in fluids, mass transfer coefficients, Distillation (binary system), gas absorption, drying and liquid extraction operations.

4. Reaction Engineering : Rate of reaction, variables affecting the rate of reaction. Interpretation of kinetic data in batch and flow systems. Theories of reaction rate, classification of reactors, design equations for batch and flow reactors.

5. Thermodynamics : First law of thermodynamics – Internal energy, Enthalpy, heat capacity, first law for open systems. Second law of thermodynamics – statement, entropy function, calculations of entropy changes. Free energy functions. Calculation of enthalpy and entropy as function of pressure and temperature, Heat effects. Criteria for equilibrium and their application.

6. Mechanical Operations : Size reduction, Properties, Handling and Mixing of particulate solids, Mechanical separations, Screening Filtration, Sedimentation, Conveying and Storage of solids.

7. Process Technology : Manufacture of following chemical products in process industries – Location and uses – Water, Soda ash, Caustic soda and Chlorine, Ammonia, Fertilizers – Industrial acids, Sulphuric acid, Nitric acid, Phosphoric acid – Industrial gases – Sugar, Pulp and paper, Cement, Electro thermal industries; Calcium carbide, Silicon carbide, Graphite, Coal chemicals, Pigments and Paints.

8. Material and Energy Balances : Basic calculations, Material balances with and without chemical reactions, energy balances, combustion.

9. Instrumentation and Process Control : Qualities of measurement, measurement of temperature, pressure and vacuum, liquid level, density and viscosity, composition and analysis. Process control – Automatic process control – Elements of a control system – Controllers modes of control and its applications.

II. ELECTIVE/SPECIALIZATION : PETRO-CHEMICALS

1. Origin of petroleum.
2. Natural Gas : Composition application as fuel.
3. Petroleum Refining : Refining of crude petroleum, production of gasoline, kerosene, heating oils and residual fuel. Lubricants, asphalts and solvents.
4. History of petrochemical industry and alternative sources.
5. Characteristics of petrochemical manufacture. Techniques involved Naphtha cracking, alkylation, isomerization and polymerization to produce petro-chemicals.
6. Petro-chemicals and their application.
7. Classification of petro-chemicals according to source
 - a) Ethylene derivatives
 - b) Derivatives of higher paraffins
 - c) Propylene derivatives
 - d) Derivatives of C₄ hydrocarbons
 - e) Derivatives of higher olefins
 - f) Derivatives of aromatics
 - g) Economic aspects of petro-chemical industry in India.

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

1. 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.

2. PHASE EQUALIBRIA AND PHASE DIAGRAMS: Gibb's rule and its interpretation; condensed system – One component system – Binary diagrams – Lever rule – Familiarity with $\text{SiO}_2 - \text{Na}_2\text{O}$, $\text{CaO} - \text{Al}_2\text{O}_3$, $\text{SiO}_2 - \text{Al}_2\text{O}_3$ – Ternary phase diagrams - Na_2O , $\text{CaO} - \text{SiO}_2$, $\text{CaO} - \text{Al}_2\text{O}_3 - \text{SiO}_2$, $\text{MgO} - \text{CaO} - \text{SiO}_2$.

3. 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

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

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

6. CHEMICAL PROPERTIES: Surface chemistry of vitreous materials – attack of water, alkalies and acids, electrode glasses, durability of glazes and enamels.

7. 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, decolourisers.

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 convection 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, pots 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 – Fibreglass – 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.

WHITEWARE 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.

REFRACTORIES

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: Manufacturing 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.

CEMENT TECHNOLOGY

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, Yttrium 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.

MATHEMATICS

Real Analysis: Continuity and differentiability of real functions.; Uniform continuity, Sequences and series of functions. Uniform convergence. Functions of bounded variation. Riemann integration.

Complex Analysis: Analytic functions. Cauchy's theorem Cauchy's integral formula. Laurent's series. Singularities. Theory of residues – Conformal mapping.

Abstract Algebra: Groups – Sub-groups – normal subgroups Quotient group Homomorphism – Fundamental theorem of Homomorphism, Permutation groups: Cayley's theorem – Rings – Subrings – Ideals – Fields – Polynomial rings.

Linear Algebra: Vector spaces – Basis and dimension – Linear transformations – Matrices – Characteristic roots and characteristic vectors – systems of linear equations – Canonical forms – Cayley – Hamilton theorem.

Differential Equations: First order ordinary differential equations (O.D.E) and their solutions – Singular solutions. Initial value problems for first order O.D.E. General theory of homogeneous and non-homogeneous linear differential equations, variation of parameters. Elements of first order partial differential equations (PDE).

Co-ordinate Geometry of Three Dimensions: The Plane – The straight-line – Sphere and cone.

PHYSICS

I. Mathematical Physics:

Vectors: Vector operators like DCI & grad, div. & curl. Surface and volume integrals – Theorems of Gauss, Stokes, & Green.

Matrices : Quality, addition and subtraction, multiplication of matrices, inverse of a matrices, similarity and unitary transformation Characteristic equation of a matrix Eigen values – Eigen vectors Square, diagonal, unit, symmetric, and skewmatrix - Hermitian and unitary matrix.

Tensors: Tensors of any order –Transformation relation Covariant & Contra-variant tensors-Christoffel symbols.

Fourier Analysis: Trigonometric Fourier series – Evaluation of coefficients – Exponential Fourier series.

II. Classical Mechanics:

General Theorems of mechanics of mass points – Principals of Virtual work – De-Alembert's principle – Lagrange's equation of motion – Hamilton's principle – Hamilton's Equation of motion – Principle of least action – Canonical transformations = Poisson bracket. Rigid body motion – Euler's theorem on rigid body motion – moment of inertia-tensor – heavy Symmetrical top.

III. Electromagnetic Theory:

Generalisation of Ampere's Law – Derivation of Maxwells equation – Pointing theorem – Transverse nature of Electromagnetic waves – propagation & Conducting and non-conducting media – metallic reflection – Propagation of light in crystalline media – Fresnel's Theory of double refraction.

IV. Special Theory of Relativity:

Galilean Transformation – Newtonians Relativity – Michelson's Morley Experiment – Postulates of special theory of relativity Lorentz's transformation – Relativistic particle mechanics Equivalence of mass & energy – Covariance of Maxwell's equation.

V. Statistical Mechanics:

Generalised coordinates & momenta-phase space, Liowellies Theorems – Maxwell Boltzman statistics – Distribution of velocities and energy in ideal gas – Equipartition of energy – Vibrational, rotational, and electronic partition functions for diatomic gas – specific heats of gas – Ortho and para hydrogen's – Bose Einstein & Fermi Dirac statistics – Bose Einstein gas and application to radiation – liquid helium – Free electrons in metals.

VI. Quantum Mechanics:

Shordinger's wave equation – Born interpretation of wave functions – Expectations values of dynamical variables – Ehrenfest's Theorem - Uncertainty Principle – Application of Shordinger's equation to (a) One dimensional squarewell potential (b) Simple harmonic Oscillator (c) Hydrogen atom.

Perturbation theory – First order and second order theories for non degenerate & degenerate systems – Application to normal helium atom – Time dependent & time independent perturbation theory – Application for each. Relativistic quantum mechanics – Klenn Garnian equation Dirac's equation Solution for a free particle meaning of negative energy states – Quantum theory of scattering – Born approximation.

VII. Electronics:

Vacuum: Tubes and semiconductor diodes – Principle and working of rectifier and power supply – Ripple factor L and T section filters voltage stabilisation in power supplies characteristics of triode and pentode and junction transistors their static characteristics – Voltage amplifiers – R.C. coupled amplifiers – and its frequency response Negative feed back in amplifiers – Advantages of – V_e feed back – condition for sinusoidal oscillations in transistor circuits Hartley and Colpitts oscillators – multi vibrators A stable – Monostable and bi-stable type – Pulse generator – Saw tooth voltage generator Cathode – ray oscilloscope (C.R.O).

VIII. Solid State Physics:

Crystallography – Classification of solids – Point group and space group – Crystal systems – Specification of planes and directions – Elements of X-ray diffraction – Various crystal bindings – Metallic, ionic, co-valent

molecular and hydrogen bonded crystals – Band theory of solids – motion of electrons in periodic potential
Bloch's theorem Kronig's penny model – energy bands – Brillouin zones – distinction between insulators –
Metals and Semi-conductors on band theory.

IX. Nuclear Physics:

Radioactivity, Chain dis-integration, transient and secular equilibrium – Age of rocks and Radio carbon
dating – alpha decay or Gamow's theory – Beta decay and neutrino Interaction of gamma rays with matter –
Selection rules – nuclear models – Liquid drop model – semi empirical mass formula – criteria for stability
against spontaneous decay – Shell model – nuclear detectors – Ionisation – Chambers – G.M. counters –
Proportional counters – bubble and spark chambers – Semi-conductor detectors.

X. Spectroscopy:

Bohr – Sommerfeld theory of Hydrogen atoms – Space quantisation – fine structure of spectral lines – Alkali
spectra – Zeeman effect Vector atom model of one electron system – Paschen – Back effect – Stark effect
in Hydrogen atoms – Band spectra – Types of band spectra-I.R. and Raman effect. Isotope effect – Franck
– Condon Principle.

ENGLISH

Detailed Study of literary age (19th Century) viz.,

The period of English Literature from 1798 to 1900 with special reference to the works of the major writers including Words worth, Coleridge, Byron, Keats, Shelley, Lamb, Hazlitt, Thackeray, Dickens, Tennyson, Browning, Arnold George Eliot, Calyle and Ruskin.

Study of the following Texts:

- | | | | |
|-----|---------------------|---|---|
| 1. | William Shakespeare | : | 'Macbeth', 'Hamlet', 'Julius Vrsdst', 'Tempest' |
| 2. | John Milton | : | 'Paradise Lost', -Books I & II |
| 3. | Alexander Pope | : | .'The Rape of the Lock' |
| 4. | William Wordsworth | : | 'The Immorality Ode', 'The Tin Tern Abbey' |
| 5. | John Keats | : | 'Ode to a Nightingale' |
| 6. | P.B. Shelley | : | 'Ode to the West Wing' |
| 7. | Jane Austen | : | 'Pride and Prejudice'. |
| 8. | Charles Dickens | : | 'A Tale of Two Cities' |
| 9. | Thomas Hardy | : | 'The mayor of Casterbridge' |
| 10. | W.B. Yeats | : | "Byzantium", 'The Second Coming'. |
| 11. | T.S. Eliot | : | 'The Waste Land'. |
| 12. | D.H. Lawrence | : | 'Sons and Lovers'. |
| 13. | Mulk Raj Anand | : | 'The Big heart' |
| 14. | R.K. Narayan | : | 'The Man eater of Malgudi' |

COMMERCIAL AND COMPUTER PRACTICE

(To teach Commerce and English Type writing & Shorthand)

01. FINANCIAL MANAGEMENT:

Corporation Finance – Economic and Managerial Aspects – Finance Education.

Financial Plan – Operating and Financial leverage – Capital Structure determinants.

Internal Financial Control – Ratio Analysis – Break-even Analysis – Sources and uses of funds statements.

Concepts of valuation and cost of capital – Cost of Debt - Cost of preference capital – Cost of Equity Capital – Cost of retained earnings – Weighted Cost of Capital.

Fundamentals of capital Budgeting – Evaluation of Investment opportunities – Pay back Accounting, Rate of Return – Discounted cash flow Techniques.

Concepts of over and under capitalisation – Working Capital management – Management of Inventories. Receivables and Cash.

Economics and Income retention – divided policy. Financial Aspects of expansion, reconstruction and recognition.

02. INDUSTRIAL ORGANISATION:

Concepts of Industry, Firm and Plant.

Size of Units – Optimum firm and representation firm – Size in Private and Public Sectors in India – Problems and Policy implications – Multi-Plant Units – Multi-Plant Units in Private and Public Sectors – Economic Problems and Policy Size and efficiency.

Location – Concepts of Location and Localisation – Location criteria – Factors influencing Localisation – Measures of Localisation – Localisation pattern in Indian Industry – Balanced Regional Development – Location development of managers – Performance Appraisal.

State and Industry – Operational Control over Private Industry.

03. LABOUR ECONOMICS AND INDUSTRIAL RELATIONS:

Labour in Industrial Society – Man Power Problems of under developed countries.

Economics of the Labour Market – Factors affecting supply and demand for labour – Concepts of full employment, unemployment – Different types of unemployment – Causes – effects and remedial measures, labour mobility – Absenteeism and turnover.

Social security and Labour Welfare – Problems of Social Security in a developing economy – Social Security in India. Settlement of Industrial Disputes – Machinery for the same.

Collective bargaining – Objectives and methods – Issues in Bargaining.

Tripartite bodies in Industrial Relations.

04. MANAGEMENT:

Organisation Concept – Different approaches to the study of Organisation. Constraints over organisational and managerial Performance. Principles of Organisation.

Planning – Business Objectives – Social responsibilities of business.

Authority, Power, Influence and the art of delegation. Span of Supervision.

Line and Staff relationships.

Bases and problems of departmentation.

Centralisation and Decentralisation.

Bureaucracy – Committee Management.

Top management functions and the role of the Board.

Control functions in organisations.

Group dynamics.

Communication – Leadership – Motivation – Morale – Training and Development of Managers – Performance appraisal.

PHARMACY

- I.
 - i) History of Pharmacy: Code of ethics in Pharmacy, Pharmacology; Principles of dispensing of mixtures, emulsion, powders and suppositories; Different types of Incompatibilities.
 - ii) Pharmacy Act; Drugs and Cosmetics Act and Rules; Drugs price control order including amendments.
 - iii) Methods of Sterilization and test for sterility; Preparation of vaccines, Sera and Anti-toxins; Manufacture of Penicillin and Streptomycin.
 - iv) Methods of classification of crude drugs; Adulteration and evaluation of crude drugs.
 - v) Pharmacognosy of Senna, Digitalis, Ispaghula, Cinchona, Cinnamon, Renwolfia, Podophyllu, Ergot Cod liver oil and Gelatin.
 - vi) Principles, instrumentation and applications of colorimetry. Spectrophotometry, fluorimetry, gas chromatography and High performance liquid chromatography.
- II.
 - i) Theory and applications of rheology (Newtonian and Non-Newtonian); Colloidal and interfacial phenomenon and their applications; Coarse dispersion (emulsions and suspensions)
 - ii) Physics-Chemical, formulation and biological factors effecting drug absorption.
 - iii) Formulation, technology and quality control of tablets, capsules, liquid crystals, aerosols, creams and ointments, injectables and sustained release medicaments.
 - iv) Structure activity relationship, synthesis, chemical nomenclature and uses of following classes of drugs – hypnotics and Sedatives; tranquilizers; Analgesics and Antipyretics; Anti-inflammatory drugs; Diuretics; anti-hypertensives and Chemotherapeutic Agents.
 - v) Pharmacology of Local anesthetics; Diuretics; Hormones; Hypoglycemic agents; Anti-histaminics; Drugs acting on central nervous system; Adrenergic and Cholinergic drugs and Cardio-vascular agents.
 - vi) Pharmacokinetic and Pharmacodynamic drug interactions with suitable examples; Teratogenicity; Drug-induced diseases.

SUGAR TECHNOLOGY

1. SUGAR MANUFACTURING PROCESS: Juice extraction - Clarification, evaporation - Pan boiling, Crystallization - Centrifugation, drying and grading - Chemicals used in sugar industry.

2. SUGAR - TECHNOLOGY:

- i. MILLING CONTROL: Mill Extraction - Reduced mill extraction, Analysis of mill performance - Calibration of vessels.
- ii. BOILING HOUSE CONTROL: Boiling house extraction-Reduced boiling house extraction, balances-importance of Chemical control.
- iii. BY PRODUCTS OF SUGAR INDUSTRY: Bagasse-Molasses-Filter cake.
- iv. WASTE WATER TREATMENT: Primary treatment of wastewater, sugar mill wastes-Breweries, wineries and distillery wastes.

3. SUGAR-ENGINEERING: Cane unloading equipment-Cane carrier and preparatory devices-Mills-Boilers-Clarification equipments-Evaporators - Pans and condensers – Crystallisers – Centrifugal - Driers and graders- Packing and storing, Spray pan-Storage vessel.

4. INSTRUMENTATION AND PROCESS CONTROL: Elements of instrumentation-Principles and operation of instruments used for measuring process variables such as temperature, pressure and vacuum, liquid level, density, viscosity, composition-process instrumentation-process control.

5. CHEMICAL PROCESS PRINCIPLES: Process engineering -Laws of conservation of mass and energy, gas laws, vapour pressure, humidity and saturation. Material and energy balances.

THERMO PHYSICS: Heat capacities of gases and gas mixtures, enthalpy changes during phase transfers.

THERMO CHEMISTRY: Heats of formation, combustion and reaction.

THERMO DYNAMICS: First and second law, ideal gas law, equations of state, phase equilibrium-simple concepts and equations for vapour- Liquid equilibria-Equilibrium constants-Temperature and pressure effects and conversion.

6. CHEMISTRY AND SUGAR CANE AGRICULTURE: Chemistry of aliphatic and aromatic compounds-Solutions-Chemical kinetics-Colloids and emulsions. Composition of cane and cane juice-Principle of polarimetry. Sugar cane cultivation-Sugar cane pests and diseases- Nutrition of sugar cane.

7. FLUID MECHANICS: Fluid statics, Newtonian and non-newtonian fluids, macroscopic energy balance, continuity equation, Bernoulli's equation, Dimensional analysis, flow through pipe line systems, flow meters, pumps and compressors. Flow through packed and fluidized beds.

8. HEAT TRANSFER: Modes of heat transfer- one-dimensional heat conduction through planes, cylindrical and spherical walls, Resistance concepts, critical insulation thickness. Heat transfer to fluids without phase change- Forced convection in laminar and turbulent flows, Natural convection, agitated vessels. Heat transfer to fluids with phase change-Boiling, condensation and evaporation. Types of heat exchangers and evaporators and their design. Fundamentals of radiation heat transfer.

9. MECHANICAL UNIT OPERATIONS: Size reduction and size separation. Free and hindered settling. Filtration, mixing and agitation. Conveying and storage of solids.

10. MASS TRANSFER OPERATIONS: Fick's laws, mass transfer coefficients, Film, Penetration and surface renewal theories. Reynold's and Colburn analogies, Continuous and stage-wise contacting and stage efficiencies principles, design and operation of equipment's for distillation, absorption and leaching.

PACKAGING TECHNOLOGY

01. Definition – Packaging criteria, appearance, protection, cost etc., - Organisation of packaging functions.
02. Role of colors and typography – Role of package shape – Product package relationship – Cost effectiveness – Cushioning design.
03. Properties and applications of paper, board and corrugated board – Metal and foils, glass and wood – Plastics and films – Adhesives and cushioning materials.
04. Introduction to moulding, thermoforming etc., - Varnishing, metallising, laser marking, electroless and electrolytic plating.
Sealing: Dielectric heat-sealing, thermal sealing and different sealing equipment's – Cushion manufacturing.
05. Aseptic packaging and biological aspects – Aerosol packaging: properties of propellants, valve, filling methods etc., - Different forms of plastics and laminate package.
06. Computer aided designing – Die designing, punching, laser die cutting – Cartooning and labeling systems.
07. Raw materials testing: Surface, physical and chemical tests, printability test.
08. Performance testing: Drop test, impact test – Shelf life calculation – half value period methods – Vibration test, Stacking and compression test.

PLASTICS AND POLYMERS

I. CHEMICAL ENGINEERING:

1. Fluid Mechanics: Dimensional analysis, fluid statics, fluid flow phenomena, basic equations of fluid flow, flow of incompressible fluids in pipes – Friction factor, Hazen-Poiseuille equation. Turbulent flow, Transportation and metering of fluids. Calculation of pump power for transportation of fluids, flow meters – orifice, Venturi and Rotameters.

2. Heat Transfer: Conduction in solids – Steady state and unsteady state. Heat flow in fluids – overall heat transfer coefficient, Log-mean temperature difference, calculation of individual heat transfer coefficient and overall heat transfer coefficient. Fouling factors, Heat transfer to fluids without phase change – Thermal boundary layer, heat transfer by forced convection in laminar flow and in turbulent flow, empirical equations; Heat transfer from condensing vapors. Heat exchange equipment – Double pipe heat exchangers and evaporators.

3. Mass Transfer: Molecular diffusion in fluids, mass transfer coefficients, Distillation (binary system), gas absorption, drying and liquid extraction operations.

4. Reaction Engineering: Rate of reaction, variables affecting the rate of reaction. Interpretation of kinetic data in batch and flow systems. Theories of reaction rate, classification of reactors, design equations for batch and flow reactors.

5. Thermodynamics: First law of thermodynamics – Internal energy, Enthalpy, heat capacity, first law for open systems. Second law of thermodynamics – statement, entropy function, calculations of entropy changes. Free energy functions. Calculation of enthalpy and entropy as function of pressure and temperature, Heat effects. Criteria for equilibrium and their application.

6. Mechanical Operations : Size reduction, Properties, Handling and Mixing of particulate solids, Mechanical separations, Screening, Filtration, Sedimentation, Conveying and Storage of solids.

7. Process Technology: Manufacture of following chemical products in process industries – Location and uses – Water, Soda ash, Caustic soda and Chlorine, Ammonia, Fertilizers – Industrial acids, Sulphuric acid, Nitric acid, Phosphoric acid – Industrial gases – Sugar, Pulp and paper, Cement, Electro thermal industries; Calcium carbide, Silicon carbide, Graphite, Coal chemicals, Pigments and Paints.

8. Material and Energy Balances: Basic calculations, Material balances with and without chemical reactions, energy balances, combustion.

9. Instrumentation and Process Control: Qualities of measurement, measurement of temperature, pressure and vacuum, liquid level, density and viscosity, composition and analysis. Process control – Automatic process control – Elements of a control system – Controllers modes of control and its applications.

II. ELECTIVE/SPECIALIZATION : POLYMERS AND PLASTICS

Introduction – Definition of Polymers, Classification of polymers, Functionality, Polymerization mechanisms – Chain polymerization (Free radical, anionic, cationic and coordination polymerization – Ziegler Natta catalyst), step polymerization (polycondensation, poly addition reactions).

Molecular weights of polymers and their determination methods – Number average molecular weight, Weight average molecular weight, Weight and viscosity average molecular weight. Methods of determination – Cryoscopy, Ebulliometry, Light scattering and Viscometric methods.

Polymerization processes: Bulk polymerization, Solution polymerization, Suspension polymerization and Emulsion polymerization.

Fabrication processes: Injection moulding, Extrusion, Blow extrusion and extrusion blow molding.

Manufacturing Methods of a few common Polymers : LDPE, HDPE, Polystyrene, Polyvinyl chloride, Phenolic resins.

Status of Indian Plastics – Industry with respect to production, location of industries, demand etc.

PETRO-CHEMICALS

I. CHEMICAL ENGINEERING:

1. Fluid Mechanics: Dimensional analysis, fluid statics, fluid flow phenomena, basic equations of fluid flow, flow of incompressible fluids in pipes – Friction factor, Hazen-Poiseuille equation. Turbulent flow, Transportation and metering of fluids. Calculation of pump power for transportation of fluids, flow meters – orifice, Venturi and Rotameters.

2. Heat Transfer: Conduction in solids – Steady state and unsteady state. Heat flow in fluids – overall heat transfer coefficient, Log-mean temperature difference, calculation of individual heat transfer coefficient and overall heat transfer coefficient. Fouling factors, Heat transfer to fluids without phase change – Thermal boundary layer, heat transfer by forced convection in laminar flow and in turbulent flow, empirical equations; Heat transfer from condensing vapors. Heat exchange equipment – Double pipe heat exchangers and evaporators.

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8. Material and Energy Balances: Basic calculations, Material balances with and without chemical reactions, energy balances, combustion.

9. Instrumentation and Process Control: Qualities of measurement, measurement of temperature, pressure and vacuum, liquid level, density and viscosity, composition and analysis. Process control – Automatic process control – Elements of a control system – Controllers modes of control and its applications.

II. ELECTIVE/SPECIALIZATION: PETROL-CHEMICALS

1. Origin of petroleum
2. Natural gas: Composition application as fuel
3. Petroleum Refining: Refining of crude petroleum, production of gasoline, Kerosene, heating oils and residual fuel. Lubricants, asphalts and solvents.
4. History of petrochemical industry and alternative sources
5. Characteristics of petrochemical manufacture. Techniques involved in Naptha cracking, alkylation, isomerization and polymerization to produce petrochemicals.
6. Petrochemicals and their application
7. Classification of petrochemicals according to source
 - a) Ethylene derivatives
 - b) Derivatives of higher paraffins
 - c) Propylene derivatives
 - d) Derivatives of C4 hydrocarbons
 - e) Derivatives of higher olefins
 - f) Derivatives of aromatics
 - g) Economic aspects of petrochemical industry in India.

MINING ENGINEERING

1. **GEOLOGY :** Structural Geology: Definition and scope. Recognition of faults, folds, joints, unconformities etc., Primary and induced structures, their importance in Mining, Bedding, Lamination, foliation, fracture, Cleat etc., field Geology; importance and scope of field Geology, field techniques, geological mapping. Use of survey equipment.
2. Principles of Stratigraphy.
3. **EXPLORATORY DRILLING:** Principles, selection of site, lay outs, details of equipment, methods of drilling and their variation, interpretation of bore hole data.
4. **EXPLOSIVES AND BLASTING:** Classification, types and use of explosives storage and transport. Blasting techniques in UG and open cast mines.
5. **SUPPORTS:** Objectives, limitations of mine supports, Types of mine supports and systematic timbering.
6. **OPENING AND CHOICE OF MINING METHODS:** Opening, development of mineral deposits, classification of mining methods, merits, demerits and application. Bord and pillar mining. Long wall mining. Open cast mining and their variations. Design of suitable methodology of mining for specific conditions like thickness, depth, inclination, annual production etc.,
7. **METAL MINING :** Scope and limitations of U/G mining methods, Classification of U/G metal mining systems and their applications in different conditions.
8. **MINE SURVEYING:** Principles of surveying. Different methods and their importance. Chain surveying. Compass ; surveying, theodolite surveying, plane tabling, levelling, triangulation, correlation. Astronomical terms and definitions. Mine plans and sections. Regulations pertaining to plans and sections.
9. **MINING MACHINERY:** Elements of transport system, classification and techno economic indices. Rope haulage, locomotive haulage, conveyers, Aerial ropeways, trackless haulage, Winding. Drainage and pumping.
10. **MINE ENVIRONMENTAL ENGINEERING:** Mine air and environment. Natural and mechanical ventilation, Types, design variables, selection, installation and maintenance. Mine fires, explosions and inundations, Rescue and recovery.
11. **MINE LEGISLATION AND SAFETY:** Regulations pertaining to conservation's, exploitation of mineral deposits. Safety welfare and hygiene of mine workers.