DELHI TECHNOLOGICAL UNIVERSITY

Established by Govt. of Delhi vide Act 6 of 2009
(FORMERLY DELHI COLLEGE OF ENGINEERING)
BAWANA ROAD, DELHI-110042

No. F.DTU/Rectt./AP/2017 Dated: 15.02.2017

NOTICE

The tentative date of screening test is 11.03.2017 for the post of Assistant Professors on regular basis in the discipline of **Applied Chemistry, Polymer Science & Chemical Technology, Civil Engineering, Management and Environmental Engineering** and the detailed schedule for screening test will be uploaded with in due course of time. The syllabus for the screening test is as under:-

Syllabus for Applied Chemistry

Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
10. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.
11. Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly- solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.

2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.

3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.

4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.

5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.

6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.

7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.

8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.

9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.

10. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.

12. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

13. Polymer chemistry: Molar masses; kinetics of polymerization.

14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.
4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitutions reactions with electophilic, nucleophilic or redical species. Determination of reactions pathways.
6. Common named reactions and rearrangements – applications in organic synthesis.
7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.
8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
9. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.
10. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
13. Structure determination of organic compounds by IR, UV-Vis, 1H & 13C NMR and Mass spectroscopic techniques.

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Syllabus for Polymer Science & Chemical Technology

Section 1: Process Calculations and Thermodynamics

Steady and unsteady state mass and energy balances including multiphase, multi-component, reacting and non-reacting systems. Use of tie components; recycle, bypass and purge calculations; Gibb's phase rule and degree of freedom analysis.

First and Second laws of thermodynamics. Applications of first law to close and open systems. Second law and Entropy. Thermodynamic properties of pure substances: Equation of State and residual properties, properties of mixtures: partial molar properties, fugacity, excess properties and activity coefficients; phase equilibria: predicting VLE of systems; chemical reaction equilibrium.

Section 2: Fluid Mechanics and Mechanical Operations

Fluid statics, Newtonian and non-Newtonian fluids, shell-balances including differential form of Bernoulli equation and energy balance, Macroscopic friction factors, dimensional analysis and similitude, flow through pipeline systems, flow meters, pumps and compressors, elementary boundary layer theory, flow past immersed bodies including packed and fluidized beds, Turbulent flow: fluctuating velocity, universal velocity profile and pressure drop.

Particle size and shape, particle size distribution, size reduction and classification of solid particles; free and hindered settling; centrifuge and cyclones; thickening and classification, filtration, agitation and mixing; conveying of solids.

Section 3: Heat Transfer

Steady and unsteady heat conduction, convection and radiation, thermal boundary layer and heat transfer coefficients, boiling, condensation and evaporation; types of heat exchangers and evaporators and their process calculations. Design of double pipe, shell and tube heat exchangers, and single and multiple effect evaporators.

Section 4: Mass Transfer

Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories; momentum, heat and mass transfer analogies; stage-wise and continuous contacting and stage efficiencies; HTU & NTU concepts; design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption.

Section 5: Chemical Reaction Engineering

Theories of reaction rates; kinetics of homogeneous reactions, interpretation of kinetic data, single and multiple reactions in ideal reactors, non-ideal reactors;

residence time distribution, single parameter model; non-isothermal reactors; kinetics of heterogeneous catalytic reactions; diffusion effects in catalysis.

Section 6: Instrumentation and Process Control

Measurement of process variables; sensors, transducers and their dynamics, process modeling and linearization, transfer functions and dynamic responses of various systems, systems with inverse response, process reaction curve, controller modes (P, PI, and PID); control valves; analysis of closed loop systems including stability, frequency response, controller tuning, cascade and feed forward control.

Section 7: Plant Design and Economics

Principles of process economics and cost estimation including depreciation and total annualized cost, cost indices, rate of return, payback period, discounted cash flow, optimization in process design and sizing of chemical engineering equipments such as compressors, heat exchangers, multistage contactors.

Section 8: Chemical Technology

Inorganic chemical industries (sulfuric acid, phosphoric acid, chlor-alkali industry), fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); petroleum refining and petrochemicals; polymerization industries (polyethylene, polypropylene, PVC and polyester synthetic fibers).

Section 9: Chemistry of high polymers

Monomers, functionality, degree of polymerizations, classification of polymers, glass transition, melting transition, criteria for rubberiness, polymerization methods: addition and condensation; their kinetics, metallocene polymers and other newer techniques of polymerization, copolymerization, monomer reactivity ratios and its significance, kinetics, different copolymers, random, alternating, azeotropic copolymerization, block and graft copolymers, techniques for copolymerization-bulk, solution, suspension, emulsion.

Section 10: Polymer Characterization

Solubility and swelling, concept of average molecular weight, determination of number average, weight average, viscosity average and Z-average molecular weights, polymer crystallinity, analysis of polymers using IR, XRD, thermal (DSC, DMTA, TGA), microscopic (optical and electronic) techniques.

Section 11: Synthesis and properties

Commodity and general purpose thermoplastics: PE, PP, PS, PVC, Polyesters, Acrylic, PU polymers. Engineering Plastics: Nylon, PC, PBT, PSU, PPO, ABS, Fluoropolymers Thermosetting polymers: PF, MF, UF, Epoxy, Unsaturated polyester, Alkyds. Natural and synthetic rubbers: Recovery of NR hydrocarbon from latex, SBR, Nitrile, CR, CSM, EPDM, IIR, BR, Silicone, TPE.

Section12: Polymer blends and composites

Difference between blends and composites, their significance, choice of polymers for blending, blend miscibility-miscible and immiscible blends, thermodynamics, phase morphology, polymer alloys, polymer eutectics, plastic-plastic, rubber-plastic and rubber-rubber blends, FRP, particulate, long and short fibre reinforced composites.

Section 13: Polymer Technology

Polymer compounding-need and significance, different compounding ingredients for rubber and plastics, cross-linking and vulcanization, vulcanization kinetics.

Section 14: Polymer rheology

Flow of Newtonian and non-Newtonian fluids, different flow equations, dependence of shear modulus on temperature, molecular / segmental deformations at different zones and transitions. Measurements of rheological parameters by capillary rotating, parallel plate, cone-plate rheometer. Visco-elasticity-creep and stress relaxations, mechanical models, control of rheological characteristics through compounding, rubber curing in parallel plate viscometer, ODR and MDR.

Section 15: Polymer processing

Compression molding, transfer molding, injection molding, blow molding, reaction injection molding, extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer.

Section 16: Polymer testing

Mechanical-static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress cracking resistance.

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Syllabus for Civil Engineering

Section 1: Engineering Mathematics Linear Algebra: Matrix algebra; Systems of linear equations; Eigen values and Eigen vectors. Calculus: Functions of single variable; Limit, continuity and differentiability; Mean value theorems, local maxima and minima, Taylor and Maclaurin series; Evaluation of definite and indefinite integrals, application of definite integral to obtain area and volume; Partial derivatives; Total derivative; Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems. Ordinary Differential Equation (ODE): First order (linear and non-linear) equations; higher order linear equations with constant coefficients; Euler-Cauchy equations; Laplace transform and its application in solving linear ODEs; initial and boundary value problems. Partial Differential Equation (PDE): Fourier series; separation of variables; solutions of onedimensional diffusion equation; first and second order one-dimensional wave equation and two-dimensional Laplace equation. Probability and Statistics: Definitions of probability and sampling theorems; Conditional probability; Discrete Random variables: Poisson and Binomial distributions; Continuous random variables: normal and exponential distributions; Descriptive statistics - Mean, median, mode and standard deviation; Hypothesis testing. Numerical Methods: Accuracy and precision; error analysis. Numerical solutions of linear and non-linear algebraic equations; Least square approximation, Newton's and Lagrange polynomials, numerical differentiation, Integration by trapezoidal and Simpson's rule, single and multi-step methods for first order differential equations.

Section 2: Structural Engineering Engineering Mechanics: System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Friction and its applications; Kinematics of point mass and rigid body; Centre of mass; Euler's equations of motion; Impulse-momentum; Energy methods; Principles of virtual work. Solid Mechanics: Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Theories of failures; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, buckling of column, combined and direct bending stresses. Structural Analysis: Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis. Construction Materials and Management: Construction Materials: Structural steel - composition, material properties and behaviour; Concrete - constituents, mix design, short-term and long-term properties; Bricks and mortar; Timber; Bitumen. Construction Management: Types of construction projects; Tendering and construction contracts; Rate analysis and standard specifications; Cost estimation; Project planning and network analysis - PERT and CPM. 18 of 72 Concrete Structures: Working stress, Limit state and Ultimate load design concepts; Design of beams, slabs, columns; Bond and development length; Prestressed concrete; Analysis of beam sections at transfer and service loads. Steel Structures: Working stress and Limit state design concepts; Design of tension and compression members, beams and beam- columns, column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses; Plastic analysis of beams and frames.

Section 3: Geotechnical Engineering Soil Mechanics: Origin of soils, soil structure and fabric; Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Darcy's law; Seepage through soils -

two-dimensional flow, flow nets, uplift pressure, piping; Principle of effective stress, capillarity, seepage force and quicksand condition; Compaction in laboratory and field conditions; Onedimensional consolidation, time rate of consolidation; Mohr's circle, stress paths, effective and total shear strength parameters, characteristics of clays and sand. Foundation Engineering: Sub-surface investigations - scope, drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes - finite and infinite slopes, method of slices and Bishop's method; Stress distribution in soils - Boussinesq's and Westergaard's theories, pressure bulbs; Shallow foundations - Terzaghi's and Meyerhoff's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations - types of piles, dynamic and static formulae, load capacity of piles in sands and clays, pile load test, negative skin friction.

Section 4: Water Resources Engineering Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum, energy and corresponding equations; Potential flow, applications of momentum and energy equations; Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth. Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Kinematics of flow, velocity triangles; Basics of hydraulic machines, specific speed of pumps and turbines; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, slope profile, hydraulic jump, uniform flow and gradually varied flow Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, flood estimation and routing, reservoir capacity, reservoir and channel routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's law. Irrigation: Duty, delta, estimation of evapo-transpiration; Crop water requirements; Design of lined and unlined canals, head works, gravity dams and spillways; Design of weirs on permeable foundation; Types of irrigation systems, irrigation methods; Water logging and drainage; Canal regulatory works, cross-drainage structures, outlets and escapes. 19 of 72

Section 5: Environmental Engineering Water and Waste Water: Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment. Unit operations and unit processes of domestic wastewater, sludge disposal. Air Pollution: Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits. Municipal Solid Wastes: Characteristics, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal). Noise Pollution: Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

Section 6: Transportation Engineering Transportation Infrastructure: Highway alignment and engineering surveys; Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments; Geometric design of railway track; Airport runway length, taxiway and exit taxiway design. Highway Pavements: Highway materials - desirable properties

and quality control tests; Design of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible pavement using IRC: 37-2012; Design of rigid pavements using IRC: 58-2011; Distresses in concrete pavements. Traffic Engineering: Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Control devices, signal design by Webster's method; Types of intersections and channelization; Highway capacity and level of service of rural highways and urban roads.

Section 7: Geomatics Engineering Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves. Photogrammetry - scale, flying height; Remote sensing - basics, platform and sensors, visual image interpretation; Basics of Geographical information system (GIS) and Geographical Positioning system (GPS).

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Syllabus for Management

Unit-I

Managerial Economics-Demand Analysis, Production Function, Cost-output relations, Market structures, Pricing theories, Advertising, Macro-economics, National Income concepts, Infrastrueture-Maaagement and Policy, Business Environment, Capital Budgeting.

Unit-II

The concept and significance of organizational behaviour-Skills and roles in an organization-Classical, Neo-classical and modem theories of organizational structure-Organizational design-Understanding and Managing individual behaviour personality-Perception-Values-Attitudes-Leaming-Motivation. Understanding and managing group behaviour, Processes-Inter-personal and group dynamics-Communication-Leadership-Managing change-Managing conflicts. Organizational· development

Unit-III

Concepts and perspectives in HRM; HRM.in changing environment, Human resource planning-Objectives, Process and Techniques, Job analysis-Job description, Selecting human resources Induction, Training and Development, Exit policy and implications, Performance appraisal and evaluation, Potential assessment, Job evaluation, Wage determination, Industrial Relations and Trade Unions, Dispute resolution and Grievance management, Labour Welfare and Social security measures

Unit-IV

Financial management-Nature and Scope, Valuation concepts and valuation of securities, Capital budgeting decisions-Risk analysis, Capital structure and Cost of capital, Dividend policy-Determinants, Long-term and short-term financing instruments, Mergers and Acquisitions

Unit-V

Marketing environment and Environment scannmg.. Marketing Information, Systems and Marketing research; Understanding consumer and industrial markets; Demand Measurement · and Forecasting; Market Segmentatton=- Targeting and Positioning; Product · decisions, Product mix, Product Life Cycle; New product development; Branding and Packaging; Pricing methods and strategies, Promotion decisions-Promotion mix; Advertising; Personal selling; Channel management; Vertical marketing systems; Evaluation and control of marketing effort: Marketing of services; Customer. relation management; Uses of internet as a marketing medium-other related issues like branding, market development, Advertising and retailing on the net. New issues in Marketing.

Unit-VI

Role and scope of production management; Facility location; Layout planning and analysis; Production planning and. control-production process analysis; Demand forecasting. for operations; Determinants of product mix; Production scheduling; Work measurement; Time and motion study; Statistical Quality Control. Role and scope of Operations Research; Linear Programming; Sensitivity analysis; Duality; Transportation model; Inventory control; Queueing theory; Decision theory; Markov analysis; ·PERT/CPM.

Unit-VII

Probability theory: Probability distributions-Binomial. Poisson, Normal and Exponential; Correlation and Regression analysis; Sampling. theory; Sampling distributions; Tests of Hypothesis; Large and small samples; t; z, F, Chi-square tests. Use of Computers in Managerial .applications; . Technology issues and Data processing in organizations; Information .systems: MIS and Decision making; System analysis and design; Trends in Information Technology; Internet and Internet-based applications.

Unit-VIII

Concept of corporate· strategy; Components of strategy formulation; Ansoff s growth vector; BCG Model; Porter's generic strategies: Competitor analysis; Strategic dimensions and group mapping; Industry analysis; Strategies in industry evolution, fragmentation, maturity. and decline; Competitive strategy and corporate strategy; Transnationalization of world economy; Managing cultural diversity; Global Entry strategies; Globalisation of financial system and services; Managing international business; Competitive advantage of nations: R"'f'P and WfO.

Unit-IX

Concepts-Types, · Characteristics; Motivation; · Competencies and its development; Innovation and Entrepreneurship; Small business=-Concepts Government policy for promotion of small tiny enterprises; Process of business opportunity identification; Detailed business plan preparation; Managing small enterprises; Planning for growth; · Sickness in Small Enterprises; Rehabilitation of sick enterprises; Intrapreneurshtp (organisattonal entrepreneurship).

Unit-X

Ethics and Management .system; Ethical issues and analysis in management; Value based organtsattons; Personal framework for ethical choices; Ethical pressure on individual in organisations, Gender issues; Ecological consciousness; Environmental ethics; Social responsibilities of business; Corporate governance and ethics.

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Syllabus for Environmental Engineering

Water Engineering: Sources of water, necessity of treatment, Critical Water quality parameters, water quality guidelines and standards for various water uses. Unit operations – principles and design of aeration systems – two film theory, water in air system, air in water system. Intake structures – Different types, design criteria. Principles of sedimentation – types of settling and settling equations, design criteria and design of settling tanks. Principle of Coagulation and Flocculation – types of coagulants, coagulant aids, coagulation theory, optimum dose of coagulant, design criteria. Filtration - theory of granular media filtration; Classification of filters; dual and multimedia filtration. Adsorption Process. Disinfection. Water Softening. Fluoridation and defluoridation – Principles and design. Ion Exchange-processes, Application Membrane Processes, Reverse osmosis, Ultrafiltration, Electrodyalisis. Corrosion and corrosion control, distribution: design of various components of the distribution system. Water supply in urban and rural areas: Locating a well, construction of well, tube wells & Ranney wells. Water lifting arrangement, source selection in hilly and rural areas. Appropriate Treatment technology for rural water supplies. Distribution system planning for rural communities. Design of Distribution system.

Waste Water Engineering: Waste Water Treatment & Disposal: Waste water characteristic, Standards of disposal, need for treatment, stream pollution and self-purification, Process kinetics. Preliminary treatment, Screens, detritus tanks, grit chambers and skimming tanks, primary treatment, septic and imhoff tanks. Secondary treatment – Trickling filters and Activated sludge process, oxidation ditches, anaerobic technologies - UASB. Disposal sewage on land and in water, sewage farming and oxidation ponds. Sludge handling, treatment and disposal. Operation & Maintenance of Sewage treatment plants. Sewerage system: Quantity of sanitary and storm sewage. Hydraulics of sewers, Design of sewers. Construction of sewage system, sewer appurtenances and sewage pumps. Design of sewerage systems and allied works. Design of sewers, integrated approach to health and sanitation. Transmission of diseases through air, water & food, Insect vector and rodent control.

Waste Management: Origin of domestic solid wastes, refuse analysis, composition & quantity of refuse & transportation of refuse, economics of refuse collection. Solid waste in industries, agricultural waste – its effect on environment. Solid waste handling methods, treatment & disposal of solid wastes. Sanitary landfill, leachates. Composting, design of composting plant, recovery of bioenergy from organic waste. Incineration. Cost economics Studies in solid waste management. Industrial waste characteristics, Effluent standards for disposal into water bodies, sewer & land. Methods of waste reduction, segregation, reuse, recycle, material conservation, recovery process optimization, neutralization, equalization, proportioning and solidification. Combined treatment of raw industrial waste with sewage, common effluent treatment for industrial estates, and selection procedure for physical, chemical & biological methods of industrial waste water treatment. Management of industrial wastes from small scale industries. Detailed considerations of waste produced from different industries in respect of processes followed, nature & quantity of wastes, their characteristics. Usual methods of waste management & treatment methods for disposal, reuse or recovery. Gross polluting industries hazardous wastes, their treatment and control.

Air & Noise Pollution: Air pollution: Definition, sources, classification. Effects on environment including living and non-living matter. Air Pollution Chemistry. Ambient Air Quality Monitoring Technique, Air Pollution indices, standards, norms, rules and regulations. An introduction to metrology, plume rise and dispersion, wind and pollution rose diagram. Air pollution control principles, basic design of air pollution control equipment such as gravitational, settling chamber, cyclone, bag filter, ESP and scrubber. Environmental Related Current Topics, Ozone Layer depletion, Carbon credit, Green bench, Carbon Sequestration, Carbon Foot prints Noise: Definition, pollution, effects, sources, permissible limit. Noise Acts.

Hydrology & Groundwater: Hydrologic cycle, World water balance, India's water balance, Types and forms of precipitation, Measurement of precipitation, Types of rain gauges, Adequacy of rain gauges, Adjustment and filling in of missing dada, Average rainfall over an area, Evaporation and its measurements, Estimation of evaporation. Infiltration: Factors affecting infiltration, Infiltrometers, Infiltration indices. Run Off, Surface run off, factors affecting run off, Hydrographs, flow rating curves and flow duration curves. Mass curve, Rainfall run-off relationship. Stream gauging, measurement of stage and velocity. Unit hydrograph. Derivation of unit hydrograph. Synthetic UH, IUH. Floods: Flood flow formulae, Frequency analysis using external type and log Pearson type III distribution, flood routing through reservoirs. Elements of Ground Water, Darcy's law, unconfined and confined aquifers, and their properties, steady and unsteady flow in wells, ground water quality, sources of pollution, remedial and preventive measures, ground water budgeting and recharging of ground water.

Environmental Hydraulics: Laminar Flow, Flow between parallel plates, Flow between coaxial cylinders, Flow through circular pipes, Power absorbed in viscous flow. Concept of friction factor. Measurement of Viscosity. Reynolds Number and its significance. Boundary Layer along a thin plate and its characteristics, Laminar Boundary Layer, Turbulent Boundary layer, laminar Sub layer, Displacement, energy and Momentum thickness, Separation of Boundary layer. Nature of Turbulent flow and its origin. Prandtl's mixing length hypothesis, Hydro dynamically smooth and Rough Boundaries. Velocity distribution for Turbulent flow in smooth and rough pipes. Friction factor in smooth and rough pipes for turbulent flow. Pipe Flow: Moody's diagram, Minor losses in pipe flow, Hardy cross Method, Concept of Equivalent Length, and Flow in parallel pipes. Open Channel Flow: Introduction, Classification of open channel flow. Geometric elements of channel section. Velocity and pressure distribution in open channel. Correction factors. Uniform flow in channels. Establishment of Manning's formulas. Energy and Specific force. Critical flow concept. Channel conveyance, Section factor for critical flow and uniform flow computation. Most economical section of a channel. Gradually Varied Flow: equations, assumptions, characteristics, classification and analysis of flow profiles. Hydraulic Jump: Definition & types, Energy loss and length of jumps. Reciprocating pumps: working principle, Indicator diagram, Frictional loss. Centrifugal pumps: Classification, specific speed, Operation in series and parallel. Turbines: Introduction, Types and their classification based on head and specific speed.

Soil Mechanics: Phase Diagram and Relationships, Index properties, clay minerals, classification and identification of soils. Soil Water: Effective and Neutral Stresses, Permeability, Seepage Analysis, Design principles of Filters, quick sand phenomenon. Stress Distribution in

Soil Mass: One dimensional theory of consolidation, consolidation test and analysis, Laboratory Compaction test, Field compaction and control. Shear Strength of Soils, Theory and Laboratory tests, cohesive and Non-cohesive soils. Theories of Earth Pressure, Bearing capacity of shallow foundations, Pile Foundation, Retaining Walls**.** Ground Improvement Techniques: Introduction to rock mechanics, Relevant IS Codes.

Analysis and Design of Structures: Principal stresses, Plane stress, Mohr's circle of stress, Components of stresses in cylindrical polar coordinates. Generalized Hooke's law, Lame's constants, Modules of rigidity, Bulk modules, Relation between the elastic constants, Principle of superposition, Uniqueness theorem, and Thermal effects. Bars of variable cross-section, thin cylindrical and spherical vessels. The moment curvature relation, Macaulay's and moment-area method, Castigliano's theorem. Types of springs, Close coiled and open coiled springs, Torsion and shear centre. Plain and reinforced concrete as per IS 456: 2000; Designs of RCC Beams, slabs, Columns, footings, and staircases in buildings. General construction in steel as per IS 800: 2007, simple joints, tension and compression members.

Surveying: Plane table Surveying: Plane table and its accessories, methods of plane tabling, two point problem, three point problems by different methods. Levelling: Introduction, types of levelling, levelling instruments, operations and adjustments of levels, ordinary levelling, errors of levelling, effect of earth's curvature and atmospheric refraction in levelling , precise levelling, modern levelling instruments, contouring: characteristics and uses of contour, modern methods of depicting relief on map. Theodolite Traversing : Transit theodolites, operation and adjustment of theodolites, horizontal angle by the method of repetition and reiteration, permanent adjustments of theodolite, theodolite traversing, traverse computations, sources of errors, check in a traverse, closing error and its adjustments, omitted measurements. Route Surveying: Reconnaissance, preliminary and location surveys of roads, railway, canal and pipe alignments, longitudinal and cross sections, computation of earthwork and mass haul curves.

Building Materials & Construction: Bricks, Stone, Lime, Timber, plywood, glass, plastics, steel, aluminium; Cement, aggregate, admixtures; Preparation and properties of concrete, concrete mix design. Introduction to destructive and non-destructive tests; Mortar; Building byelaws, modular co-ordination; Loads on buildings; Types of foundations and selection criteria; Brick masonry, stone masonry, bonds. Types of walls, partition and cavity walls, design criteria. Prefabricated construction. Plastering and pointing. Dampness in buildings, its causes and effects. Damp proofing materials and techniques. Types of floors, construction details and selection criteria. Types of roofs and roof covering, treatment for water proofing. Doors and windows: sizes and locations, materials. Stair and staircases: types, materials, and proportions. Lifts and escalators. White washing, colour washing, painting, distempering. Shuttering, scaffolding and centering. Expansion and construction joints. Acoustics & sound and fire proof construction, I.S. specifications.

Earth Sciences, GIS & Remote Sensing: Branches of geology, origin, age and interior of earth, earth movements, importance in Engineering. Minerals: Physical and optical properties of rock & ore forming minerals. Geological Agencies. Weathering, erosion by running waters, glaciers wind and oceans and their engineering importance. Structural Geology: Dip, strike, folds, faults

& joints and their engineering aspects. Geo Chemistry: Effect of rocks on the quality of ground water, surface waters, the causes of salinity; Introduction to GIS, components of GIS, database structure, Vector and Raster method. Fundamentals of Remote Sensing, Physics of Remote sensing. Atmospheric interaction, Scattering, reflection, absorption and transmission platforms and sensors, ground truth, remote sensing data for mapping, Image Interpretation.

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