

B. Tech. in CIVIL & ENVIRONMENTAL ENGINEERING

Syllabus of Paper - 1

BUILDING MATERIAL AND CONSTRUCTION

Building Materials: Stone, Lime, Glass, Plastics, Steel, FRP, Ceramics, Aluminum, Fly Ash, Basic Admixtures, Timber, Plywood, Bricks and Aggregates: Classification, properties and selection criteria, IS specification. Cement: Types, Composition, Properties, Uses and specifications. Tests on cement-normal consistency, initial setting, final setting, tensile and compressive strengths, unsoundness, fineness, heat of hydration. Aggregates: Classification, properties, porosity and absorption, bulking of sand, sieve analysis; grading curves, fineness modulus, impurities and tests on aggregates. Lime and Cement Mortars. Concrete: Properties, workability-Slump Test, Compaction-factor test and Vee-Bee consistometer test; bleeding, shrinkage and creep, mixing and placing of concrete, compressive and tensile strengths, effects of water-cement ratio, compaction, age, curing temperature on strength of concrete, Modulus of elasticity. Poisson's ratio, Design of concrete mixes: Proportioning of aggregates, IS, ACI and other methods of mix design. Building Construction: Building byelaws, Loads on buildings. Types of foundations and selection criteria. Brick masonry, stone masonry, bonds. Types of walls, partition and cavity walls, design criteria. Pre-fabricated construction. Plastering and pointing. Dampness in buildings: its causes and effects. Damp proofing materials and techniques. Floors Construction: 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.

STRENGTH OF MATERIALS

Stress and Strain: Introduction, Mechanical properties, simple stress and strains, elastic constants, principal stress. Mohr's circle, simple bending and shear of the beam. Bending Moment and Shear Force Diagrams: Introduction, Shear force and bending moment diagrams of cantilever beams, simply supported beam, over hanging beams of different types of loadings. Deflection: Introduction, Deflection due to bending, moment curvature relation, Double integration method, Macaulay's method, moment area method, and conjugate beam method. Columns and Struts: Introduction, types of columns, Modes of failure of columns, Effective length, slenderness ratio, Eulers theory, Rankine's theory. Torsion of Shaft. Introduction, Torsion of shafts: Introduction, Torsion of circular shafts, Assumptions, Resisting torque, Power transmitted, Design of shafts.

ENGINEERING & ENVIRONMENTAL SURVEYING

Introduction to Surveying: Introduction: Object & scope of surveying, classification of Surveying, principles of surveying, surveying instructions, Basic Surveying Techniques: Chain Surveying ; Instruments of chain surveying, corrections to measured lengths, measurement of offsets, limiting length of offsets, field work of chain surveying, booking of field notes, conventional symbols, obstacles in chain surveying, errors in chain surveying & their corrections. Compass surveying:

instructions in compass surveying, system of recording the bearing, determination of meridian compasses, traversing & graphical method of adjustment. Plain table Surveying and Leveling: Plane table Surveying: Plane table and its accessories, methods of plane tabling, two point problem, three point problems by different methods. Leveling: Introduction, types of leveling, leveling instruments, operations and adjustments of levels, ordinary leveling, errors of leveling, effect of earth's curvature and atmospheric refraction in levelling, precise leveling, modern leveling instruments, contouring: characteristics and uses of contour, modern methods of depicting relief on map. Areas and Volume: Areas, Volume and Earthquake Computations : Different methods of determination of areas from plan, areas of irregular boundaries, areas of field notes by latitudes and departure methods, instrumental methods of determining areas, areas of cross section, determination of earthquake volumes. Theodolite Traversing: 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. Tacheometric Surveying: Tacheometric surveying : principle of stadia method, instrument constants, Anallatic lens, Distance and elevation of stations, subtense method, tangential method, errors, subtense bar and its use.

ENGINEERING ANALYSIS AND DESIGN

Design of Beam: Reinforced Cement Concrete, concrete making materials, workability of the concrete, Types of steel reinforcement, types of concrete mixes, characteristics strength of steel and concrete, design principles, Limit state of collapse in flexure, shear and bond. Singly and doubly reinforced beam rectangular and T- Beam. Design of Column: Introduction, classification of columns. Effective length of column, reinforcement in column, design of axially loaded short column, IS 456: 2000 specification of the columns. One Way and Two Way Slab :Introduction, one way and two way slab, load distribution in a slab, IS 456: 2000 recommendations of the slab, design of one way and two way slabs. Foundations: Introductions, classifications of Foundations, analysis of isolated footings, design steps of isolated rectangular footings, Design of strip footings, design of combined footings. Steel Structure : Introduction, Steel elements, Riveted and Welded joints, Simple tension and compression member.

STRUCTURAL ANALYSIS

Classification of Structures, Stress Resultants, Degree of Freedom per node, Static and Kinematic degrees of indeterminacy. Work and Energy. Strain energy of deformable systems, Betti's theorem of reciprocal work and Maxwell's theorem. Principle of virtual work and complementary virtual work, Principle of total minimum stationary potential energy, Stable and unstable equilibrium, Castigliano's Theorem I and II. Analysis of determinate beams and plane frames. BM, SF and Axial thrust diagrams, Rolling loads, Influence lines diagrams Reaction, SF, BM, for determinate beams. Floor beams. ILD for Slope and Deflections in simple beams. Classification of pin jointed determinate trusses. Analysis of plane, complex, compound and simple space trusses. Method of tension coefficient, graphical method of substitution. Maxwell's diagram to analyse simple trusses. Deflection due to bending: The moment curvature relation, Macaulay's method, Moment area and Conjugate beam method, Deflection of determinate plane frames using strain energy and unit load method, Elastic curve sketch. Analysis of arches: Linear arch, Eddy's theorem, three hinged parabolic arch, Spandrel braced arch. Influence line diagrams for Horizontal truss, BM RSF, NT. Stability of

Columns: Study of ideal rigid columns, two bar and three bar systems. Euler's formula for long columns, Columns with eccentric axial loads, Rankine's formula.

GEOTECHNICAL ENGINEERING

Phase Diagram and Functional Relationships, Index properties and their determination, Soil classification systems, Soil Water, Effective and Neutral Stresses. Permeability and its laboratory determination, Seepage Analysis and Flow Nets, Design principles of Filters. Stress Distribution in Soil Mass due to surface loading. One dimensional consolidation, Terzaghi's theory Consolidation test and analysis, Consolidation settlement, Compaction, Laboratory test, Field compaction and control. Shear Strength of Soil: Theory and Laboratory tests, cohesive and Non-cohesive soils. Stability of slopes: analysis of finite and infinite slopes. Theories of Earth Pressure including graphical methods, Bearing capacity of Shallow Foundations, Pile Foundations including pile groups and well foundations., and deep foundations.

FLUID MECHANICS & HYDRAULIC MACHINES

Introduction: Properties of fluids, types of fluids and continuum principle. Fluid Statics: Basic definition, hydro statics law, Pascal's law, manometers, hydro statics forces on submerged surfaces, buoyancy. Kinematics of flow: Types of flow, streamline, path line, principle of conservation of mass, velocity, acceleration, velocity potential and stream function, vorticity and circulation. Fluid dynamics: Euler's equation, Bernoulli's equation, and its application, Pitot tube, venturimeter, Orifices and mouth pieces. Laminar and turbulent flow in pipe: Laminar flow through pipes, velocity distribution, turbulent flow, Reynolds equation, Prandtl's mixing length theory, velocity distribution in pipe flow and plate flow, Darcy's weisbach equation, friction factor, water hammer. Dimensional analysis and models: Dimensional homogeneity, Rankines and Buckingham's pie theorem, dimensionless numbers, Types of models and model analysis. Boundary layer theory: Concept of boundary layer, laminar and turbulent boundary layers, boundary layer thickness, laminar sub-layer, hydro dynamically smooth and rough boundaries, cavitations. Hydraulic Machines: Introduction, Dynamics forces on curved and bends, Elements of hydroelectric power plants, head and efficiencies of hydraulic turbines, classification of turbines, Pelton wheel turbine, working proportions of Pelton wheel, design of Pelton wheel runner, study and design Francis turbine, Draft tube theory, Kaplan turbine, working proportions of Kaplan turbine, Efficiency, specific speed and unit quantities, centrifugal and reciprocating pumps.

HYDROLOGY & GROUNDWATER ENGINEERING

Precipitation: Scope of hydrologic cycle, World water balance, India's waterbalance, Types and forms of precipitation, Measurement of precipitation, Types of rain gauges, Adequacy of rain gauges, Adjustment and filling in of missing data, Average rainfall over an area, Basic statistics and frequency analysis. Evaporation: Evaporation and its measurements, Estimation of evaporation. Formulae of Penman, Thornthwaite and Blaney-Criddle method. Evaporation control. 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: 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. Ground Water: Elements of Ground Water modeling:-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.

Syllabus of Paper - 2

ENVIRONMENTAL CHEMISTRY & MICROBIOLOGY

Aquatic chemistry: Hydrological cycle, Chemical structure of water molecule, unusual properties of water, solubility of solids and gases in water, Carbonate cycle, pH of water, Chemical Equilibrium, Redox reactions. Application of principles of chemistry for solving environmental engineering problems. Water Pollution: Chemistry of pollution due to nutrients (CNP), Oxygen demanding wastes, salts, detergents, heavy metals, pesticides, hydrocarbons, PCBs, radioactive compounds. Atmospheric Chemistry: Composition of atmospheric layers, sources of air pollution, major pollutants of air, chemistry of photochemical smog formation, acid rain, ozone depletion; green house effect and global warming. Environmental Microbiology: Microbial taxonomy, Classification of morphological aspects of bacteria, algae, fungi, protozoa, and other aquatic micro flora; microbial growth and dynamics; pure and mixed cultures; Aerobic and Anaerobic metabolism; microbial transformation of organic matter (CNPS), acclimatization of waste; microbial inhibition mechanisms. Role of Microbes in Environment: Role of micro-organisms in wastewater treatment, and air pollution control (bio-scrubbers); microbial degradation of ligno-cellulosic material, pesticides, hydrocarbons; microbial precipitation of heavy metals.

WATER ENGINEERING: DESIGN & APPLICATION

Water supply engineering : water demand, design period, population forecasting, source of water, hydrological concepts, ground water and its development, conveyance of water, pipe materials, corrosion, laying of pipes, pipe appurtenances , pumps for water supply, distribution system, planning of water supply projects. Characteristics of Water: Physical, Chemical and Microbiological quality parameters. Drinking water quality criteria and standards. Coagulation, common coagulants and coagulant aids and their reactions. Mixing and flocculation basin design. Sedimentation, design principles, discrete and flocculant suspensions, sedimentation tank details. Filtration, gravity and pressure filters, single and multimedia filters. Water softening by chemical precipitation and ion exchange. Aeration of water to remove iron and manganese and taste and odour. Disinfection, disinfectants, chlorination of water supplies. Miscellaneous methods of water treatment O & M of Water treatment plants, Domestic & Industrial water treatment.

WASTEWATER ENGINEERING: DESIGN AND APPLICATIONS

Design of various primary units in a Sewage Treatment Plant, Coarse screens, Fine screens, Oil & Grease Trap, Grit Chamber, Primary Sedimentation Tank. Design of secondary treatment units, Activated sludge process, Trickling filter, Oxidation ditch, oxidation pond. Design of Imhoff Tank, Septic Tank, RBC etc. Upflow Anaerobic Sludge Blanket. Design of sludge digestion, Incineration etc. Application of the concepts of nonlinear optimization to waste water treatment design. Design of sewer networks & optimization.

INSTRUMENTATION TECHNIQUES FOR ENVIRONMENTAL MONITORING

Fundamentals: The Significance and Application of Measurement. Functional Elements of Generalized Measuring System. Classification of Measuring Instruments, Introduction of Microprocessors and advantages of Microprocessor based instrumentation. Management of Data in quantitative analysis: Accuracy, precision, types of errors, Minimization of error, statistical analysis

and curve fittings. Standards of Measurement and its classification. Calibration of instruments and its importance. Transducers, measurement of non electrical quantities like pressure, temperature, flow and level etc. Spectro-analytical Method: Colorimetry, Spectrophotometer, Fluorimetry, Nephelometry, Turbidimetry, Flame Photometry, Atomic, absorption and emission Spectrophotometer. Chromatography Method: Classification, Principal and application of Chromatography – Gas chromatography, GC-MS, HPLC, Ion Chromatography, Paper chromatography and thin layer Chromatography Electro Analytical Method: Conductometry Potentiometry, Colorimetry and Polarography. Continuous Monitoring instruments and their principals: NDIR for CO, Chemiluminescence analysis for NO_x and fluorescence analysis for SO₂.

SOLID WASTE MANAGEMENT

Sources, Composition & Properties of Municipal solid waste. Handling & Separation of solid waste, Municipal Waste (Management & Handling Rules, 2000), Integrated solid waste management (SWM) System, Hierarchical approach for SWM. Solid Waste Collection & Transportation: Types of collection systems (Hauled- container system & Stationary container system), Collection routes & their Layout, Solid waste transfer stations. Solid waste generation and collection rates; Waste handling and separation, storage and processing at source, solid wastes collection methods, separation, processing, and transformation of solid wastes, transfer and transport of solid wastes. Methods of Disposal of Municipal Solid Waste Landfills: Classification, Types & methods, Site selection, Site preparation, Composition, Characteristics, Generation, & Control of Landfill gases; Composition, Formation, Movement & control of leachate in landfills; landfill design. Re-vegetation of closed landfill sites, Long term post closure plan, Groundwater monitoring during & after closure. Transformation and recycling of waste materials; Composting: Theory of composting, Manual and mechanized composting, Design of composting plan, Recovery of bioenergy from organic waste. Thermal Conversion Technologies: Incineration, Pyrolysis & Gasification Systems. Types & design of Incinerators.

AIR POLLUTION & CONTROL

Sources and classification of Air Pollution Effects of Air Pollution on Human health, plants, Animals and Property. Sampling and measurement in ambient, Work Place and stack. Meteorology- Concept of Atmosphere, wind movements, Windrose Diagram and Measurement of Meteorological Variables. Atmospheric lapse rates, Adiabatic lapse rate and their consequences, Plume behaviour. Plume rise equation, estimation of stack height. Pollution control Method of a Particulate matter: Types of Particulate control methods-Settling chambers, cyclone separators, scrubbers, filters and Electrostatic precipitators- Mechanism, Their design and application. Gaseous Pollution control method and Automobile Pollution: Types of gaseous Pollution Control method- absorption, adsorption and combustion process. Automobile pollution- Sources of pollution, composition of auto exhaust & control method. Air Pollution Legislation and Global Problem: Air Quality Standard, Ambient Air Quality Standard and Emission standard. Air Pollution, legislation and regulation in India. Air Pollution Indices. Global problem of air pollution and its remedial measure. Air Pollution from major Industrial Operations.

VIBRATION ANALYSIS & CONTROL OF NOISE POLLUTION

Basics of Sound, Sound propagation in air, Indoor sound propagation, Fundamentals of Noise, Difference between sound and noise, Sound Power, Sound Intensity, Sound Pressure Levels, Measurement of noise, Sources of noise, Outdoor and Indoor Noise Propagations, Ambient noise level standards. Noise pollution in India, Factors Affecting Noise Pollution, Road Traffic Noise Monitoring, Ambient Noise Monitoring, Occupational Noise Monitoring, Vibration monitoring, traffic noise data analysis, health effects of noise. Highway Traffic Noise: noise from vehicles, effects of operating conditions on vehicle noise levels, individual sources of vehicle noise, assessment of road traffic noise, traffic noise rating, practical aspects of traffic noise measurement, prediction of noise levels due to highway traffic. Train Noise: introduction, elements of train noise, diesel engine noise, transmission noise, rail-wheel interaction noise, vibration from railway vehicles, modelling of train noise. Aircraft Noise: introduction, assessment of community reaction to aircraft noise, sources of aircraft noise, aircraft noise prediction, control of aircraft noise. Noise Control Measures, Industrial noise control, Principles of Noise Pollution Control, Sound Absorption, Basics about Noise Barrier, Design of Noise Barrier, Vibration Damping, Muffling, Green Belt for Noise Attenuation.

INDUSTRIAL WASTE MANAGEMENT

Properties of Water, Polar & Non-polar Solvents, True Solutions, Emulsification, Colloidal Suspensions, and Mixtures made stable by Chelating Agents. Management of Industrial Wastes: Solid, Liquid and Gaseous waste, Management of Industrial Wastewater, Management of Solid Wastes from Industries, and Management of Discharges to the Air. Waste Characterization Study, Wastes Audit, Characteristics of Industrial Wastewater, Characteristics of Discharges to the Air, Characteristics of Solid Waste Streams from Industries. Wastes from Industries : Textile Wastes; Dairy wastes; Slaughterhouse, Poultry and fish processing waste; Tannery Wastes; Sugar Mill Wastes; Pulp and Paper Mill Waste; Fermentation Industry Waste; Engineering Industry Waste; Petroleum and Petrochemical wastes; Fertilizer and Pesticides Industry waste; Wastes from vegetable, food and allied industries, Rubber Waste. Pollution Prevention: General Approach, Source Reduction, Waste minimization, concentration and volume reduction, segregation, reuse, recycle, material conservation, recovery, Benefits of Pollution Prevention. Methods for Treating Wastewaters from Industry: Wastewater Treatment Mechanisms, Waste Equalization, pH Control, Chemical Methods of Wastewater Treatment, Biological Methods of Wastewater Treatment, Physical Methods of Wastewater Treatment. Treatment and Disposal of Solid Wastes from Industry: Landfilling, Incineration, Composting Industrial Wastes, Solidification and Stabilization of Industrial Solid Wastes. Methods for Treating Air Discharges from Industry: Reduction at Source, pollutant classification and treatment.
