Elective Subjects	3L:0T:0P	3 Credits

PEC-CE 550 Rural Water Supply & onsite Sanitation Systems

Syllabus:

Concept of environment and scope of sanitation in rural areas, the magnitude of problems of rural water supply and sanitation, population to be covered, difficulties, national policy.

Water supply: Design population and demand loads. Various approaches to planning water supply schemes in rural areas. Development of preferred sources of water springs, Wells, infiltration wells and infiltration galleries, collection of raw water from a surface source. Specific practices and problems encountered in the rural water supply.

Improved methods and compact systems of treatment of surface and ground waters for rural water supply, Brief Details of multi-bottom settlers (MBS), Diatomaceous earth filters, cloth filter, cloth filter, slow sand filter, chlorine diffusion cartridges. Pumps, pipe materials, appurtenances and improved devices for use in rural water supply, planning of distribution system in rural areas.

Community and sanitary latrines, various methods of collection and disposal of night soil, planning of wastewater collection system in rural areas, treatment and disposal of wastewater.
Compact and simple wastewater treatment units and systems in rural areas such as stabilization ponds, septic tanks, Imhoff tank, soak pit, etc, Disposal of wastewater soakage pits and trenches.

Disposal of solid waste, composting, landfilling, incineration, Biogas plants, Rural health. Other specific issues and problems encountered in rural sanitation.

Text Books :

1. Metcalf &Eddy,"Wastewater Engineering: Treatment and Reuse", McGraw Hill Education Pvt. Ltd. (India)Noida.
2. Sanjay Gupta,"RuralWater Supply and Sanitation", Vayu Education of India 2/25, Ansari Road, Darya Ganj, NewDelhi-110002.
3. 'Water Treatment and Sanitation – Simple Method for Rural Area' by Mann H.T. and Williamson D.
4. 'Water Supply for Rural Areas & Small Communities' by WangeE.G. and LanoixJ.N.,
5. WHO 'Water Supply and Sewerage', by E.W.Steel&T.J.Mcghee, McGrawHill.

PEC-CE 551 Structural Analysis-I

Syllabus:

Classification of Structures, degrees of freedom per node, Static and Kinematic determinacy. Classification of Pin jointed determinate trusses, Analysis of determinate plane and space trusses, Method of tension coefficient.

Rolling loads, influence lines for beams and trusses, Absolute maximum bending moment, Muller-Breslau's principal & its application for determinate structures

Strain Energy of deformable systems, Maxwell's reciprocal &Betti's theorem, Castigliano's first theorem, unit load & Conjugate beam methods.

Unsymmetrical bending, location of the neutral axis, computation of stresses and deflection, Shear Centre its location for common structural section, Bending of curved bars in the plane of bending, stresses in bars.

Text Books

1. Reddy, C.S., "Basic Structural Analysis", Tata McGraw Hill.

References Books

1. Hibbler, Structural Analysis, PearsonEducation
2. Wilbur and Norris, "Elementary Structural Analysis", Tata McGrawHill.
3. Vazirani&Ratwani, Analysis of Structures ,KhannaPublishers

PEC-CE 552 Structural Analysis-II

Syllabus:

Analysis of Beams & Strain Energy Method

Analysis of fixed beams, Continuous beams, Method of Consistent Deformation, Strain Energy: Introduction, Principle of Superposition, Castigliano's Theorems, Conjugate beam method

Slope-Deflection

Slope-Deflection Method: Introduction, Beams (Continued), Frames Without Sideways, Frames with Sideways,

Moment-Distribution Method

The Moment-Distribution Method: Introduction, Statically Indeterminate, Beams With Support Settlements, Frames without Sideways, Frames with Sideways

Muller-Breslau's Principle & Applications

Muller-Breslau's Principle and its applications for drawing influence lines for indeterminate beams, Analysis of two hinged arches.

Suspension Bridges
Analysis of cables with concentrated and continuous loadings, Basics of two types of supports, Applications of Static and Kinematic theorem for Plastic Analysis of Beams

Text Book

1. *Theory of Structures* by S.*Ramamrutham*&R.Narayan, Reprint 2014, Dhanpat rai & Co (p) ltd.

Reference books

1. Theory and Analysis of Structures, Vol. I & II by O. P. Jain & B. K. Jain, NemChand&Bros.,Roorkee.
2. Theory of Structures by S. P. Timoshenko and D. Young, Mc-Graw Hill BookPublish- ing Company Ltd., NewDelhi.

PEC-CE 553 Design of Concrete Structures-I

Syllabus:

Introduction: Stress-strain characteristics of concrete and steel, Grades of concrete and steel, Fatigue effects, Types of loads and load combinations, Factor of Safety, Introduction to Various Design Philosophies, Design of Rectangular Singly and Doubly Reinforced Sections by Working Stress Method.

Design of RC Beams: Assumptions in Limit State Design Method, Design of Rectangular Singly and Doubly Reinforced beams, T-beams, L-beams by Limit State Design Method

The behavior of RC Beam in Shear: Shear Strength of beams with and without shear reinforcement, Minimum and Maximum shear reinforcement, design of beam in shear, Introduction to development length, Anchorage bond, flexural bond. (Detailed Examples by Limit State Design Method), Failure of a beam under shear, Concept of Equivalent Shear and Moments.

Design of Slabs: Design of one-way and two-way solid slabs by Limit State Design Method, Serviceability Limit States, Control of deflection, cracking, and vibrations.

Design of Columns: Design of Columns by Limit State Design Method- Effective height of columns, Assumptions, Minimum eccentricity, Short column under axial compression, requirements for reinforcement, Column with helical reinforcement, Short column under axial load and uniaxial bending, Design of columns under bi-axial loading by Design Charts.

Note: All designs shall be conforming to IS: 456 – 2000.

Text Books/Manual:

1. IS 456 – 2000.
2. Fundamentals of Reinforced Concrete by M L Gambhir,PHI,
3. Reinforced Concrete Design by S. Unnikrishnan Pillai & D. Menon, TataMc-Graw

Reference Books

1. Plain and Reinforced Concrete Vol. I & II by O. P. Jain & Jai Krishna, Nem Chand &Bros.
2. Reinforced Concrete Structures by R. Park andPauley.
3. Reinforced Concrete Design by P. Dayaratnam., Oxford &IBH

Supplementary Websites for references:

1. E- learning NPTEL Lectures (Web :-http://nptel.ac.in/)

PEC-CE 554 Design of Concrete Structures-II

Syllabus:

Nature of Stresses in flat slabs with and without drops, the coefficient for the design of flat slabs, reinforcement in flat slabs. (IS Code Method).

Analysis and design of beam curved in plan. Structural behaviour of footings, design of footing for a wall and a single column, combined rectangular and trapezoidal footings, Design of strap footing.

Structural behaviour of retaining wall, stability of retaining wall against overturning and sliding, design of T-shaped retaining wall, Concept of Counter fort retaining wall, Loads, forces and I.R.C. bridge loadings, Design of R.C. slab culvert.

Design criteria, material specifications and permissible stresses for tanks, design concept, of circular and rectangular tanks situated on the ground / underground, design of overhead tanks.

Advantages of prestressing, methods of prestressing, losses in prestress, analysis of simple prestressed rectangular and T-section.

Note: All designs shall be conforming to IS: 456 – 2000.

Text Books:

1. IS: 456 – 2000.
2. Fundamentals of Reinforced Concrete by M L Gambhir,PHI,
3. Reinforced Concrete Design by S. Unnikrishna Pillai & D. Menon, TataMc-Graw

Reference Books

1. Plain and Reinforced Concrete Vol. I & II by O. P. Jain & Jai Krishna, Nem Chand &Bros.
2. Reinforced Concrete Structures by R. Park andPauley.
3. Reinforced Concrete Design by P. Dayaratnam., Oxford &IBH

Supplementary Websites for references:

1. E- learning NPTEL Lectures (Web :-http://nptel.ac.in/)

PEC-CE 555 Pre-stressed Concrete

Syllabus:

Introduction: Theory and Behaviour basic concepts – Advantages – Materials required – Systems and methods of prestressing -analysis of sections – Stress concept – Strength concept – Load balancing concept – Effect of loading on the tensile stresses in tendons – Effect of tendon profile on deflections – Factors influencing deflections – Calculation of deflections – Short term and long-term deflections -Losses of prestressing – Estimation of crack width

Design Concepts: Flexural strength – Simplified procedures as per codes – strain compatibility method – Basic concepts in the selection of cross-section for bending – stress distribution in end block, Design of anchorage zone reinforcement- Limit state design criteria- Partial prestressing-Applications.

Circular prestressing design of prestressed concrete tanks – Pipes

Composite Construction: Analysis for stresses – Estimate for deflections – Flexural and shear strength of composite Members

Pre-Stressed Concrete Bridges: General aspects – pretensioned prestressed bridge decks – Post tensioned prestressed bridge decks – Principles of design only.

Text Books

1. Krishna Raju N., Prestressed concrete, Tata McGraw Hill Company, New Delhi1998
2. Mallic S.K. and Gupta A.P., Prestressed concrete, Oxford and IBH publishing Co.Pvt.Ltd. 1997.
3. Rajagopalan, N, "Prestressed Concrete", Alpha Science,2002

Reference Books

1. Ramaswamy G.S., Modern prestressed concrete design, Arnold Heinimen, NewDelhi, 1990
2. Lin T.Y. Design of prestressed concrete structures, Asia Publishing House,Bombay 1995.
3. David A.Sheppard, William R. and Philips, Plant Cast precast and prestressedconcrete

– A design guide, McGraw Hill, New Delhi 1992.

Supplementary Websites for references:

E- learning NPTEL Lectures(Web :- http://nptel.ac.in/)

PEC-CE 556 Design of Steel Structures

Syllabus:

Introduction: Properties of steel – Structural steel sections – Limit State Design Concepts – Loads on Structures – Metal joining methods using rivets, welding, bolting – Design of bolted, riveted, and welded joints – Eccentric connections - Efficiency of joints – High Tension bolts

Tension members: Types of sections – Net area – Net effective sections for angles and Tee in tension– Design of connections in tension members – Use of lug angles – Design of tension splice – Concept of shear lag

Compression members: Types of compression members – Theory of columns – Basis of current codal provision for compression member design – Slenderness ratio – Design of single section and compound section compression members – Design of lacing and battening type columns – Design of column bases – Gusseted base.

Design of laterally supported and unsupported beams – Built-up beams – Beams subjected to biaxial bending – Design of plate girders riveted and welded – Intermediate and bearing stiffeners – Web splices – Design of beam-columns

Roof trusses and industrial structures: Roof trusses – Roof and side coverings – Design loads, design of purlin and elements of truss; end bearing – Design of gantry girder

Text Books

1. Dayaratnam, P., "Design of Steel Structures", Second edition, S. Chand & Company, 2003

References

1. Ramachandra, S., "Design of Steel Structures – Vol. I & II", Standard Publication, New Delhi
2. "Teaching Resources for Structural Steel Design – Vol. I & II", INSDAG,Kolkatta.
3. Gaylord, E.H., Gaylord, N.C., and Stallmeyer, J.E., "Design of Steel Structures",3rd edition, McGraw-Hill Publications,1992

Supplementary Websites for references:

1. E- learning NPTEL Lectures(Web :-http://nptel.ac.in/)

Text Books

1. Industrial waste water treatment by A.D.PATWARDHAN, PHI Learning Pvt.Ltd
2. Environmental Pollution and Control, Prof. P.R. Trivedi, APH Publishing,2004

Recommended References:

1) Standard Methods for the Examination of Water andWastewater,

2) by Eugene W. Rice(Editor), Rodger B. Baird(Editor), Andrew D.Eaton (Editor), Lenore S. Clesceri (Editor), American Public Health Association, 2012
3) Wastewater Reuse and Recycling Technology Pollution Technology Review 72, Culp, Gordan, George Wasner, Robert Williams and Mark ,V.Hughes Jr., Noyes Data Corporation, New Jersey.
4) The Treatment of Industrial wastes. Edmund, B. BesselieveP.E., McGraw Hill, New York.
5) Wastewater Engineering: Treatment & Re use. Metcalf &Eddy, Tata Mc GrawHill.

PEC-CE 556 Foundation Engineering

Syllabus:

Vertical pressures under surface loads, Elastic Solution, Bousisinesq and New Mark Charts, Westergaard's equation, approximate solution.

Bearing capacity and settlement analysis of shallow foundations: Meyerhof and Hansen's bearing capacity equations, BIS bearing capacity equation, immediate and consolidation settlements in cohesive soil, De-Beer and schmmertman's methods of settlement prediction in non-cohesive soil.

Classification of piles, the load-carrying capacity of single piles in clay, silt, and sand by dynamic and static methods, Pile load test, Pile group, Negative skin friction, Settlement of pile group

Foundation on expansive soil, Construction on expansive soil, Alteration of soil condition, under-reamed piles, Elements of well foundation, Shape, Depth of scouring, Well sinking, Tilt, shift and their prevention.

Stability of slopes, Limit equilibrium method, Method of slices, Simplified Bishop method, Stability Charts.
Machine foundation: classification, definitions, design principle, in brief, Barken's method.

Text Books :

2. Aysen- Problem Solving In SoilMechanics
3. B.H. Fellenius - Basics of FoundationDesign
4. K. R. Arora – Soil Mechanics & FoundationEngineering.
5. Alam Singh – Modern GeotechnicalEngineering.
6. Gopal Ranjan and A. S. R. Rao – Basic and Applied SoilMechanics

PEC-CE 557Concrete Materials

Syllabus:

Examines the influence of constituent materials (cement, aggregates, and admixtures) on the properties of fresh and hardened concrete; Recycled aggregates recovered from construction and demolition wastes; M-Sand; Light-weight aggregates; Use of Fly Ash in concrete; Fibre-reinforced concrete with various types of metallic and nonmetallic fibers; various types of concrete such as Self Compacting Concrete, High-Performance Concrete, etc.; mix design; handling and placement of concrete; Effect of revibration of concrete; behavior of concrete under various types of loading and environment; test methods. Laboratory practice is an integral part of the course.

PEC-CE 558PAVEMENT MATERIALS

Syllabus:

Soil - Classification, characteristics, compaction, evaluation of soil strength; stabilized pavement materials; Aggregates: requirements, properties, and tests on road aggregates for flexible and rigid pavements. Bitumen: Origin, preparation, properties and tests, the constitution of bituminous road binders; requirements; Criterion for selection of different binders. Bituminous Emulsions and Cutbacks: Preparation, characteristics, uses, and tests, Bituminous Mixes: Mechanical properties: Resilient modulus, dynamic modulus, and fatigue characteristics of bituminous mixes. Bituminous mix design methods and specifications, weathering, and durability of bituminous materials and Mixes, Performance-based Bitumen Specifications; Superpave mix design method: design example problems. Cement Concrete for Pavement Construction: Requirements, and design of mix for CC pavement, IRC and IS specifications and tests, joint filler, and sealer materials.

PEC-CE 559 PAVEMENT DESIGN

Syllabus:

Introduction: Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements.Stresses and Deflections in Flexible Pavements: Stresses and deflections in homogeneous masses. Burmister'stwo layer theory, three-layer and multi-layer theories; wheel load stresses, various factors in traffic wheel loads; ESWL of multiple wheels, repeated loads and EWL factors; sustained loads. Pavement behavior under transient traffic loads. Flexible Pavement Design Methods For Highways and Airports: Empirical, semi-empirical and theoretical approaches, development, principle, design steps, advantages; design of flexible pavements as per IRC; Stresses in Rigid Pavements: Types of stresses and causes, factors influencing the stresses; general considerations in rigid pavement analysis, EWL; wheel load stresses, warping stresses, frictional stresses, combined stresses. Rigid Pavement Design: Types of joints in cement

concrete pavements and their functions, joint spacings; design of CC pavement for roads and runways as per IRC, design of joint details for longitudinal joints, contraction joints, and expansion joints. IRC method of design by stress ratio method. Design of continuously reinforced concrete pavements; Maintenance, repair, and rehabilitation of pavements including design of bituminous and concrete overlays as per IRC.

PEC-CE 560Geometric Design of Highways

Syllabus:

Introduction: Classification of rural highways and urban roads. Objectives and requirements of highway geometric design; Design Controls: Topography, vehicle characteristics and design vehicle, driver characteristics, speed, traffic flow and capacity, levels of service, pedestrian and other facilities, environmental factors; Design Elements: Sight distances, Horizontal alignment - design considerations, stability at curves, super elevation, widening, transition curves; curvature at intersections, vertical alignment - grades, ramps, design of summit and valley curves, combination of vertical and horizontal alignment including design of hair pin bends, design of expressways, IRC standards and guidelines for design problems; Cross Section Elements: Right of way and width considerations, roadway, shoulders, kerbs traffic barriers, medians, frontage roads; Facilities for pedestrians, bicycles, buses and trucks, Pavement surface characteristics - types, cross slope, skid resistance, unevenness; Design Considerations: Design considerations for rural and urban arterials, freeways, and other rural and urban roads; Design Of Intersections: Characteristics and design considerations of at-grade intersections;; Rotary intersections; Grade separations and interchanges -; Design of Parking lots.

PEC-CE 561Airport Planning and Design

Aircraft characteristics; Aircraft performance characteristics: Airport planning and air travel demand forecasting: Airport Site Selection; Geometric Design of the Airfield: Determination of Runway Capacity and Delay - Taxiway and Gate Capacity - Holding Aprons - Terminal Aprons – Airport drainage - Function of Airport Passenger and Cargo Terminal - Design of Air Freight Terminals - Airport access - Airport Landside planning - Capacity; Air Traffic Management: Navigational aids: ground-based systems, satellite-based systems – Air traffic control and surveillance facilities – Airfield lighting - air traffic management. Prerequisite.

PEC-CE 562Intelligent Transportation Systems:

Syllabus:

Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data

collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.Telecommunications in ITS – Importance of telecommunications in the ITS system, Information Management, Traffic Management Centres (TMC). Vehicle – Roadside communication – Vehicle Positioning System; ITS functional areas – Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS); ITS User Needs and Services – Travel and Traffic management, Public Transportation Management, Electronic Payment, Commercial Vehicle Operations, Emergency Management, Advanced Vehicle safety systems, Information Management; Automated Highway Systems - Vehicles in Platoons – Integration of Automated Highway Systems. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

PEC-CE 562 Railway Engineering

Syllabus:

Railway track gauge, alignment of railway lines, engineering surveys and construction of new lines, tracks and track stresses; rails, sleepers; ballast; subgrade and formation, rack fittings and fastenings, creep of rails, geometric design of track, curves and super-elevation, points and crossings, track junctions and simple track layouts; rail joints and welding of rails; track maintenance, track drainage; modern methods of track maintenance, rehabilitation, and renewal of track; tractive resistance and power, railway stations and yards; railway tunnelling; signalling and interlocking; maintenance of railways and high-speed trains.

PEC-CE 563 Urban Transportation Planning

Syllabus:

Urban morphology - Urbanization and travel demand – Urban activity systems and travel patterns – Systems approach – Trip based and Activity-based approach - Urban Transportation Planning – Goals, Objectives and Constraints - Inventory, Model building, Forecasting, and Evaluation - Study area delineation – Zoning - UTP survey; Trip generation models – Trip classification - productions and attractions – Trip rate analysis - Multiple regression models - Category analysis - Trip distribution models – Growth factor models, Gravity model, and Opportunity modes; Modal split models – Mode choice behaviour – Trip end and trip interchange models - Probabilistic models - Utility functions - Logit models – Two-stage model. Traffic assignment – Transportation networks – Minimum Path Algorithms - Assignment methods – All or Nothing assignment, Capacity restrained assignment and Multipath assignment - Route-choice behaviour; Land use transportation models – Urban forms and structures - Location models - Accessibility – Land use models -

Lowry derivative models - Quick response techniques - Non-Transport solutions AICTE Model Curriculum for Undergraduate degree in Civil Engineering (Engineering & Technology) 152 | Page for transport problems; Preparation of alternative plans - Evaluation techniques - Plan implementation - Monitoring - Financing of Project – urban development planning policy - Case studies.

PEC-CE 564 Port and Harbour Engineering

Syllabus:

Harbour Planning: Types of water transportation, water transportation in India, requirements of ports and harbours, classification of harbours, selection of site and planning of harbours, location of harbour, traffic estimation, master plan, ship characteristics, harbour design, turning basin, harbour entrances, type of docks, its location and number, Site investigations – hydrographic survey, topographic survey, soil investigations, current observations, tidal observations; Docks and Repair Facilities: Design and construction of breakwaters, berthing structures - jetties, fenders, piers, wharves, dolphins, trestle, moles, Harbour docks, use of wet docks, design of wet docks, repair docks, lift docks, dry docks, keel and bilge blocking, construction of dry docks, gates for dry docks, pumping plant, floating docks, slipways, locks, size of lock, lock gates, types of gates; Navigational Aids: Requirements of signals, fixed navigation structures, necessity of navigational aids, light houses, beacon lights, floating navigational aids, light ships, buoys, radar; Dredging and Coastal Protection: Classification, types of dredgers, choice of dredger, uses of dredged materials, coastal erosion and protection, sea wall, revetment, bulkhead, coastal zone and beach profile; Port facilities: Port development, port planning, port building facilities, transit sheds, warehouses, cargo handling facilities, container handling terminal facilities, shipping terminals, inland port facilities. Inland waterways, Inland water transportation in India, classification of waterways, the economics of inland waterways transportation, national waterways.

PEC-CE 565Traffic Engineering and Management

Syllabus:

Traffic Forecast: General travel forecasting principles, different methods of traffic forecast - Mechanical and analytical methods, Demand relationships, methods for future projection; Design Hourly Volume for Varying Demand Conditions: Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Price-volume relationships, demand functions. Determination of design hourly volume; critical hour concept; Highway Capacity: Factors affecting capacity, level of service; Capacity studies - Capacity of different highway facilities including unsignalized and signalised intersections. Problems in Mixed Traffic flow; Case studies; Accident Analysis: Analysis of individual accidents and statistical data; Methods of representing accident rate; Factors in traffic accidents; influence of roadway and traffic conditions on traffic safety; accident coefficients; Driver strains due to roadway

and traffic conditions; Traffic Flow Theory: Fundamental flow relationship and their applications, Traffic flow theories and applications; Shock waves; Queuing theory and applications; Probabilistic Aspects Of Traffic Flow: Vehicle arrivals, distribution models, gaps and headway distribution models; gap acceptance merging parameters, delay models, applications; Simulation: Fundamental principle, application of simulation techniques in traffic engineering - formulation of simulation models, Case studies. Formulation of system models.

PEC-CE 566 Construction Project Planning& Systems

Syllabus:

Definition of Projects; Stages of project planning: pre-tender planning, pre-construction planning, detailed construction planning, the role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, the concept of productivities, estimating durations, sequence of activities, activity utility data; Techniques of planning- Bar charts, Gantt Charts. Networks: basic terminology, types of precedence relationships, preparation of CPM networks: activity on link and activity on node representation, computation of float values, critical and semi-critical paths, calendaring networks. PERT Assumptions underlying PERT analysis, determining three-time estimates, analysis, slack computations, calculation of the probability of completion. Allocation of Resources- materials, equipment, staff, labour and finance; resource levelling and optimal schedules; Project organization, documentation and reporting systems. Control & monitoring; Temporary Structures in Construction; Construction Methods for various types of Structures; Major Construction equipment; Automation & Robotics in Construction; Modern Project management Systems; Advent of Lean Construction; Importance of Contracts Management; Planning and organizing construction site and resources- Site: site layout including enabling structures, developing site organization, Documentation at the site; Manpower: planning, organizing, staffing, motivation; Materials: concepts of planning, procurement, and inventory control; Equipment: basic concepts of planning and organizing; Funds: cash flow, sources of funds; Histograms and S-Curves. Earned Value; Resource Scheduling- Bar chart, line of balance technique, resource constraints and conflicts; resource aggregation, allocation, smoothening, and leveling. Common Good Practices in Construction; Project Monitoring & Control- Supervision, record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency, and methods of updating. Common causes of time and cost overruns and corrective measures. Basics of Modern Project management systems such as Lean Construction; Use of Building Information Modelling (BIM) in project management; Quality control: the concept of quality, quality of constructed structure, use of manuals and checklists for quality control, the role of inspection, basics of statistical quality control. Safety, Health and Environment on project sites: accidents; their causes, effects, and preventive measures, costs of accidents, occupational health problems in construction, organizing for safety and health.

PEC-CE 567 Repair & Rehabilitation of Structures.

Syllabus:

Maintenance and Repair Strategies Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration; Strength and Durability Of Concrete- Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness; Special Concretes- Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes; Techniques for Repair and Protection Methods- Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection; Repair, Rehabilitation and Retrofitting of Structures- Evaluation of root causes; Underpinning & shoring; some simple systems of rehabilitation of structures; Guniting, shotcreting; Non-Destructive testing systems; Use of external plates, carbon fibre wrapping and carbon composites in repairs. Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – Demolition Techniques – Engineered demolition methods – Case studies.

PEC-CE 568Transport of water and wastewater

Syllabus:

The objective of the course is to make students gain insight into how the water and wastewater get transported through conduits and open channels and use the same for the design, operation, and maintenance of these systems. Water Supply Systems: Storage requirements, impounding reservoirs, intake structures, pipe hydraulics, design of distribution systems, distribution and balancing reservoirs, pipe materials, appurtenances, design for external loads, maintenance, and operation. Sanitary Sewerage Systems: Flow estimation, sewer materials, hydraulics of flow in sewers, sewer layout, sewer transitions, materials for sewers, appurtenances, manholes, sewer design, conventional and model-based design, sewage pumps and pumping stations, corrosion prevention, operation and maintenance, safety. Stormwater Drainage Systems: Drainage layouts, storm runoff estimation, hydraulics of flow in stormwater drains, materials, cross-sections, design of stormwater drainage systems, inlets, stormwater pumping, operation, and maintenance Environmental Laws and Policy. Overview of environment, nature, and ecosystem, Concept of laws and policies, Origin of environmental law, Introduction to environmental laws and policies, Environment and Governance, sustainable development and environment, understanding climate change, carbon credits, carbon footprint, etc., Introduction to trade and environment. International

environmental laws, Right to Environment as Human Right, International Humanitarian Law, and Environment, environment and conflicts management, Famous international protocols like Kyoto.

PEC-CE 569 Physico-Chemical Processes for Water and Wastewater Treatment

Syllabus:

The objective of this course is to provide an in-depth understanding of the physical and physicochemical processes used for water and wastewater treatment systems and to provide the capability to design such systems. Water purification in natural systems, physical processes, chemical processes, and biological processes. Primary, secondary and tertiary treatment. Unit operations, unit processes. Aeration and gas transfer. Sedimentation, different types of settling, sedimentation tank design. Coagulation and flocculation, coagulation processes, stability of colloids, destabilization of colloids, destabilization in water and wastewater treatment, transport of colloidal particles, design aspects. Filtration: filtration processes, Hydraulics of flow through porous media, Rate control patterns and methods, Filter effluent quality parameters, a mathematical model for deep granular filters, slow sand filtration, rapid sand filtration, precoat filtration, design aspects. Disinfection: Types of disinfectants, Kinetics of disinfection, chlorination and its theory, Design of Chlorinators. Precipitation: Hardness removal, Iron, Mn, and heavy metal removal; Adsorption, adsorption equilibria, and adsorption isotherm, rates of adsorption, Sorption kinetics in batch reactors, continuous reactors, factors affecting adsorption. Ion Exchange-exchange processes, materials, and reactions, methods of operation, Application, design aspects. Membrane Processes, Reverse osmosis, Ultrafiltration, Electrodialysis.

PEC-CE 570 Biological Processes for Contaminant Removal

Syllabus:

Understanding of basics of microbiology, metabolism and energetics, biokinetic parameter, reactors, and reactor analyses. Characterization of waste. Aerobic, anaerobic, and anoxic systems. Suspended and attached growth biological systems. Activated Sludge process and process modifications, Process design considerations, Treatment Ponds and aerated Lagoons, aerobic pond, facultative pond, anaerobic ponds, polishing ponds, constructed wetlands, etc. Attached are Growth Biological Treatment Systems, Trickling Filters, Rotating Biological Contactors, Activated Biofilters, Moving bed biological reactor (MBBR), Sequential Batch reactors (SBR), Membrane Biological Reactors (MBR), etc. Anaerobic processes, Process fundamentals, Standard, high rate and hybrid reactors, Anaerobic filters, Expanded /fluidized bed reactors, Up-flow anaerobic sludge blanket reactors, Performance, and design aspects, Expanded granular bed reactors, Two-stage/phase anaerobic reactors. Sludge Digestion, anaerobic digestion, aerobic digestion.

PEC-CE 571 Air and Noise Pollution Control

Syllabus:

Air pollutants, Sources, classification, Combustion Processes, and pollutant emission, Effects on Health, vegetation, materials and atmosphere, Reactions of pollutants in the atmosphere and their effects-Smoke, smog and ozone layer disturbance, Greenhouse effect. Air sampling and pollution measurement methods, principles and instruments, Ambient air quality and emission standards, Air pollution indices, Air Act, legislation and regulations, control principles, Removal of gaseous pollutants by adsorption, absorption, reaction, and other methods. Particulate emission control, settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators, and other removal methods like absorption, adsorption, precipitation, etc. Biological air pollution control technologies, Indoor air quality. Noise pollution: Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point, and line sources, multiple sources; outdoor and indoor noise propagation; psychoacoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infrasound, ultrasound, impulsive sound and sonic boom; noise standards and limit values; noise instrumentation and monitoring procedure. Noise indices, Noise control methods

PEC-CE 572 Solid and hazardous waste management

Syllabus:

Solid Wastes: Origin, Analysis, Composition, and Characteristics. Integrated Solid Waste Management System: Collection, Storage, Segregation, Reuse and Recycling possibilities, Transportation, Treatment / Processing and Transformation Techniques, Final Disposal. Management of: Municipal, Biomedical, Nuclear, Electronic, and Industrial Solid Wastes and the rules and regulations. Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem; Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery, Transportation of hazardous waste, Physical, chemical and biological treatment, Groundwater contamination, Landfill disposal, Current Management Practices, Environmental audit, Pollution Prevention, Facility Development and operation, Site Remediation: Quantitative risk assessment, site and subsurface characterization, Containment, remedial alternatives.

PEC-CE 573Water and Air Quality Models

Syllabus:

Introduction to Mathematical Models: water quality model development, calibration and verification cost: benefit analysis using models, Model requirements and limitations. D.O. Models for Streams: Dissolved oxygen model for streams sources and sinks of dissolved

oxygen estimation of system parameters Streeter Phelps model oxygen 'sag' curve-determination of deoxygenation and re-aeration coefficients- Benthal oxygen demand mass transport mechanisms- Models for Estuary and Lakes: Physical-chemical and biological processes in estuaries; Air quality models: Micrometeorological processes, the wind rose, dispersion, coefficients and stability classes, Gaussian and dispersion model, Stack height computation, Regional air quality models, Source inventories and significance.

PEC-CE 574 Environmental impact assessment and life cycle analyses

Syllabus:

Evolution of EIA: Concepts of EIA methodologies, Screening and scoping; Rapid EIA and Comprehensive EIA; General Framework for Environmental Impact Assessment, Characterization and site assessment. Environmental Risk Analysis, Definition of Risk, Matrix Method. Checklist method, Fault tree analysis, Consequence Analysis; Socioeconomic aspects, measures of the effectiveness of pollution control activities; Environmental Legislation; Introduction to Environmental Management Systems; Environmental Statement - procedures; Environmental Audit: Cost-Benefit Analysis; Life Cycle Assessment; Resource Balance, Energy Balance & Management Review; Operational Control; Case Studies on EIA.

PEC-575 Groundwater Engineering

Syllabus:

The main objective is to provide sufficient knowledge to the students about the groundwater hydrology, well hydraulics and well construction, geophysical explorations, groundwater quality and management of groundwater resources; Problems and perspectives regarding groundwater in India; Hydrogeology: Darcy's Equation; flow characteristics; general flow equations; unsaturated flow; Well Hydraulics: Steady and unsteady radial flows in aquifers; partially penetrating wells; multiple well systems; characteristic good losses; specific capacity, Surface and Subsurface investigations (Geologic methods; remote sensing; geophysical explorations; electrical resistivity and seismic refraction), Water Wells: Construction; completion, development, protection, and rehabilitation of wells; Groundwater quality; Groundwater Management: Basin management, investigations, conjunctive use, modeling, artificial recharge; Saline water intrusion.

PEC-CE 576 Concrete Technology

Syllabus:

Concrete; Properties of ingredients, tests, Production of concrete, mixing, compaction curing, Properties of fresh concrete; Defects in Concrete, Concrete additives.; Behaviour of concrete

in tension and compression, shear and bond, Influence of various factors on test results, Time-dependent behaviour of concrete -creep, shrinkage and fatigue; Concrete mix design; Proportioning of concrete mixes, basic considerations, cost specifications, factors in the choice of mix proportion, a different method of mix design. Quality control, Behaviour of concrete in extreme environment; temperature problem in concrete, hot weather, cold weather and underwater conditions, Resistance to freezing, sulphate and acid attack, efflorescence, fire resistance; Inspection and testing of concrete. Concrete cracking, types of cracks, causes and remedies Non-destructive tests on concrete; Chemical tests on cement and aggregates; Special concrete; types and specifications, Fibre reinforced and steel Fibre reinforced concrete, Polymer concrete, Use of admixtures; Deterioration of concrete and its prevention Repair and rehabilitation.

PEC-CE 577 Bridge Engineering

Syllabus:

General; classification of bridges, site selection, geometric and hydraulic design consideration, loading standards for highway and railway bridges, general design consideration; optimum spans; Concrete bridges: culverts; Slab, T-beam, box girder bridges, balanced cantilever bridge, cable-stayed bridge, extrados bridges; arch bridge; Special requirements for Prestressed Concrete bridges; Steel bridges: plate girder bridge, truss bridge, suspension cable bridge, cable-stayed bridge; Substructures: design of piers and abutments, pile and well foundations, bearings and expansion joints, special wearing coats; seismic design considerations; Aerodynamic stability considerations; special durability measures; provisions for inspection and maintenance.

PEC-CE 578 Earthquake Engineering

Syllabus:

Theory of Vibrations; Concept of inertia and damping - Types of Damping - Difference between static forces and dynamic excitation - Degrees of freedom - SDOF idealization - Equations of motion of SDOF system for mass as well as base excitation - Free vibration of SDOF system - Response to harmonic excitation - Impulse and response to unit impulse - Duhamel integral; Multiple Degree of Freedom System; Two degree of freedom system - Normal modes of vibration - Natural frequencies - Mode shapes - Introduction to MDOF systems - Decoupling of equations of motion - Concept of mode superposition (No derivations); Elements of Seismology; Causes of Earthquake - Geological faults - Tectonic plate theory - Elastic rebound – Epicentre; Hypocentre - Primary, shear and Raleigh waves - Seismogram - Magnitude and intensity of earthquakes - Magnitude and Intensity scales - Spectral Acceleration - Information on some disastrous earthquakes; Response of Structures to Earthquake; Response and design spectra - Design earthquake - concept of peak acceleration - Site specific response spectrum - Effect of soil properties and damping -

Liquefaction of soils - Importance of ductility - Methods of introducing ductility into RC structures Design Methodology IS 1893, IS 13920 and IS 4326 - codal provisions - Design as per the codes - Base isolation techniques - Vibration control measures - Important points in mitigating effects of earthquake on structures