SYLLABUS FOR

Ph.D

ENTRANCE TEST

IN

CIVIL ENGINEERING

DEPARTMENT

STRUCTURAL ENGINEERING

Subject: Advanced Reinforced Concrete Structures

Concrete Technology: Concrete as structural material, strength of concrete and its significance, Strength porosity relationship, Factors effecting compressive strength, Behavior of concrete under stress states, Durability of concrete and its significance, Sulphate attack, Alkali aggregate reaction, Corrosion of embedded steel in concrete and concrete deterioration due to corrosion of steel and its preventive measures.
Design of Slender Columns: Concentrically loaded slender columns, Eccentrically loaded slender columns, Slender columns subjected to axial and transverse loads, Structural behaviour of columns in braced and unbraced frames, Codal procedure for design of slender columns.
Flat Slabs: Elements of flat slabs, Codal procedure for design of flat slabs, Behaviour of flat slab in shear, One way and two way shear, Opening in flat slabs, Effect of pattern loading in flat slabs.
Deep Beams: General features, Parameter influencing design, Flexural bending and shear stresses in deep beams. Design provisions of IS-456, Checking for local failures, Detailing of reinforcement in deep beams.
Over Head Service Reservoir: Special design considerations, Design requirements of materials, Complete design and drawing details of an overhead service reservoir.
Yield Line Analysis: Design of slabs of various shapes and having various support conditions using yield line analysis approach.
Design of Beam Column Joints: Types of joints, Joints in maltistoreyed buildings, Forces acting on joints, Design of joints for strength, Anchorage requirement in joints and detailing of reinforcement in joints.

References:

1. Advanced R.C.Design by Krishna Raju.
2. Limit State Design by A.K. Jain.
3. Reinforced Concrete Structures by Park and Pauley.
4. Reinforced Concrete Structural Elements – Behaviour Analysis and Design by Purushothaman.
5. Concrete Technology by M.S. Shetty.

Subject : Dynamic Of Structures

Single Degree of Freedom Systems: Fundamental, Mass spring damper system, Analysis of free vibrations, Response to harmonic loading, periodic loading, Impulsive loading and general dynamic loading. Generalised SDOF, Vibration analysis by Rayleigh method.
Multi Degree of Freedom Systems: Two degree of freedom system – undamped, free & forced. Multidegree of freedom system- undamped, Holter method, Stodola'method, Orthogonality condition, Damped system. Dynamic analysis and Response- Modal Analysis, Response spectrum analysis, Rayleigh's-Rit z method.

Structures With Distributed Mass And Load: Axial, shear and transverse vibration due to bending of beams, Uniform shear beam, Beam in bending, Numerical techniques for shear beam, Bending of beams, Forced vibration, Plates or slabs subjected to normal loads.
Earthquake Motion And Response: Introduction, Strong motion earthquake, Numerical method for spectra, Elastic spectra, Ground velocity and displacement, Inelastic spectra, Equivalent linear system, Comparison of an elastic and inelastic system.
Aseismic Design of Structures: Design data and philosophy of design, Seismic co-officient, permissible increase in stress and load factor for multistoreyed buildings, Base shear, Fundamental time period of buildings, Distribution of forces along the height, Dynamic analysis using IS:13912, Earthquake resistant construction of buildings, Ductility provision in reinforced concrete construction of structures, Design of water towers, Stack like structures.
Introduction to Machine Foundation Design: Introduction, Design criteria for satisfactory action of machine foundation, Design of reciprocating and impact machines as per IS : code provision, Dynamic analysis of block foundation,
Hydrodynamic pressures: Impulsive pressure, Corrective pressure, Hydrodynamic pressure on Dams, Vertical component of reservoir load, Dynamic moments & shears.

References:

1. Dynamics of Structures by John's Biggs.
2. Elementary Earthquake Engineering by Jai Krishna & Chander Shekhran.
3. Dynamics of Structures by Janes Biggs.
4. Earthquake Resistant Design by Dowrick-Wiley.
5. Dynamic of Structures by Walter c. Hurty & Moshe F.Rubinsten.
6. Dynamics of structures by Anil K.Chopra.
7. Dynamic of Structures by Clough and Penzein.

Subject: Advanced Steel Structures

Concept of Plastic Design: Introduction, Theory of plastic bending, Assumptions, Bending of rectangular section, Plastic hinge, Redistribution of moments, Computation of plastic moment, Shape factor, Overload factor, Method of plastic analysis : Statical Method, Mechanism method, Upper bound, Lower bound and uniqueness theorem, Partial, Complete and over complete failure of indeterminate structures.

Plastic Analysis of Frames: Plastic analysis of portal frames subjected to transverse and lateral loads, Analysis of gable frames, Analysis of multibay multistoreyed frames, Moment balancing method.
Minimum Weight Design: Concept, Assumptions, Design of frames with prismatic members, Elements of linear programming and its applications to minimum weight design problems.
Deflections: Assumption, Calculation of deflection at ultimate loads, Deflection at working loads, Rotation capacity.
Secondary Design Consideration: General, Influence of axial force on the plastic moment, Influence of shear force, Local buckling of flanges and webs, Lateral buckling.

Plastic Design of Steel Frames: General design procedure, Design of continuous beams, Design of industrial building frames.
Light Gauge Steel Structures: Introduction, Types of section, Unstiffened, stiffened and multistiffened elements, Local buckling of thin elements, Design of compression members, Design of flexural members- Laterally supported and laterally unsupported members, Connections.

References:

1. Plastic Design by Neal.
2. Plastic Design of Steel Frames by LYNNS.Beedle.
3. The steel skeleton Volume I and II by J.F. Baker Publication English Language Book Society.
4. Steel Structure- Design And Behaviour Salmon And Johnson Publication Harper And Row.
5. Structural Steel Designer's Hand Book by Merritt.
6. Plastic analysis of steel structures by Hedge G. Philips.
7. Handbook for Structural Engineers,SP:6(6)-1972.

Subject: Advanced Structural Analysis

Stiffness Method: Basis of stiffness method, Influence coefficients, Kinematic indeterminacy, Degree of freedom, Action displacement relationship, Direct stiffness approach, Transformation of axes system, Representing the imposed loads as nodal loads, Elastic supports, Support displacements, Application to various type of structures e.g. Continuous beams, Trusses, Frames and grids, Temperature effects.
Flexibility Method: Particular solution, Complimentary solution, Compatibility equations, Flexibility coefficients, Application of complimentary energy principles, Basis of the method, Numerical integration for flexibility coefficients, Application to various type of structures, Elastics supports, Supports displacement, Temperature shrinkage, Imperfect fit, Analysis of pin jointed trusses, Rigid frames.
Finite Element Method: Introduction, Basic steps in finite element method, Coordinate systems, Rotation of axes, Shape functions, Elements stiffness matrix and load vector, Triangular element in plane stress and strain, Numerical integration, Isoperametric elements, Rectangular elements in plate flexure, Triangular element in plate flexure, Rectangular element in plane stress and bending combined, Computer programs for these elements.

References:

1. Matrix Analysis of Framed Structures by Gere and Weaver.
2. Analysis of Indeterminate Structures by C.K. Wang.
3. Finite Element Methods by Zeiekiwitz and Cheung.
4. Advance Structural Analysis by A.K.Jain.
5. Introduction to Finite Element Method by C.S.Desai and John F. Abel.

Highways Engineering

Subject: Highway Planning & Geometric Design

Highway planning: Planning Service, Saturation System, Policies and goals of different road development plans, Salient features of Vision-2021 as per IRC recommendations. 6

Geometric design standards of Highways: Controls and Criteria for geometric design, basic requirements, Design vehicle, Design of capacity, level of service, design of camber, design methods used in field, design of cross-section elements, design and analysis of different sight distances IRC specifications for design. 8

Design of Horizontal Alignment: Design and analysis of super elevation, methods for eliminating camber and buildings super elevation in the field, design of extra widening, methods for providing extra widening in the field, design of transition, design of combined curve, IRC specifications for design. 6

Design of Vertical Alignment: Design of gradients, basic criteria and methods for designing summit and & valley vertical curves, IRC specification for design. 4

Geometric Design of Inter-sections: Design elements of intersections, elaborate design of rotary intersection, grade separated intersections, median separators. 10

Design of parking areas: Design of Bus terminals, loading and unloading zones 4

Geometric design of high speed corridors: Concept and requirement of high speed corridors and design of high speed corridors. 6

References/Text Books:

1. L.R. Kadiyali, Principles and Practices of Highway Engg.
2. O'Flaherty, Highways and Traffic Engg.
3. Partha chakraborty and Animesh dass, Principles of Transportation Engg.
4. C. John Khisty and B Kent Lall, Transportation Engg.
5. Relevant IRC Codes for designing
6. Pocket book of Highway engineers (2002)

Subject: Pavement Analysis & Design

Importance and functions of various components of pavement structures, concept of wheel loads and tandem axles, ESWL, vehicle damage factors. 10

Design of Flexible pavements: CBR method of flexible pavement design. Old concepts to be recent concept by IRC-37-2001, Design by group index method, Design of low cost roads. 14

Design of rigid pavement: Factors affecting, Analysis of stresses, equivalent wheel load, Westergaard's analysis, IRC design guidelines, design of joints, tie bars, dowel bars, CRCP, FRC and pre-stressed concrete pavements. 12

Pavement Distress, Evaluation and Strengthening: Causes of Pavement distress, Pavement evaluation, need for overlay, overlay design methods for flexible pavements and rigid pavements, rigid overlays for flexible pavements. 14

References:

1. Yoder E.J. and Witezak M.W. Principles of pavement design.
2. Sharma S.K. Principles, practice and design of Highway Engineering.
3. O'Flaherty, Highway Engg. Vol-2.

Subject : Highway Materials Design & Construction

Low cost and soil stabilized roads: Classification, low cost roads, use of local and waste materials, stabilisation techniques 14

Bituminous materials and mixes: Terminology, classification, distillation, grades, asphalts and tars, testing methods and specifications, bitumen aggregate interactive mechanism, design of bituminous mixes 12

Intermediate and high type bituminous pavements: Concept of macadam roads, Bituminous surface treatments, Road mix and bituminous plant mixes, bituminous bound macadam, asphalt and concrete, Bituminous concrete laying procedures, use of admixtures, construction methods and machinery 14

Rigid pavements: Base course function, design of pavement grade mixes, Construction equipment, methods, quality control and procedures, pumping, joint fillers and sealants, mix selection, compaction methods and construction procedures for reinforced and pre-stressed pavements. 12

References:

1. Krebs and Walker- Highway Materials, Mcgraw Hill Book Co.
2. Sharma S.K. Principles, practice and design of highway engineering

Subject : Advanced Traffic Engineering

Introduction : Traffic characteristics, PIEV theory, Traffic flow Characteristics, capacity and level of service concept. 8

Traffic studies: Traffic Volume, spot speed, speed & delay, axle load surveys, Origin & Destination study, sampling techniques, presentation of traffic data, analysis and applications

Traffic facilities design: Design of parking facilities, Design of lighting and terminal facilities 6

Traffic Operations and Control: Traffic regulation, Traffic control devices i.e. signs and markings, design of traffic signals.

Traffic Safety: Effect of road conditions on traffic safety, Accident study, presentation and analysis of traffic data, improvement measures. 6

Intelligent Transport System: Highway communication, automatic vehicle detection, electronic toll collection system, advanced driver information system, simulation of traffic systems. 10

References/ Text Books:

1. Kadiyali,L.R. Traffic Engineering and transport planning, Khanna Publishers.
2. Matson T.M., Smith W.S. and Hurd F.W., Traffic Engineering, McGraw Hill Book Co.
3. O. Flaherty: Highways and Traffic Volume-I
4. S.K. Khanna & C.E.G.Justo: Highway Engineering
5. K.B.Woods: Traffic Engineering Hand Book
6. Relevant IRC Codes

ENVIRONMENTAL ENGINEERING

Subject : Environmental Chemistry & Microbiology

Environment Chemistry

Basic concepts of chemistry involved in water & wastewater analysis: Basic concepts of General chemistry, Physical chemistry, Equilibrium chemistry, Organic chemistry, Bio chemistry, Colloidal chemistry, Nuclear chemistry. Basic concepts of quantative chemistry: Sampling Gravimetric analysis, Volumetric analysis, Colourimetry, Spectrophotometry. Industrial Methods of Analysis, Optical Methods; Electric Methods Chromatographic methods.

Chemistry of Turbidity, colour, pH, Acidity, Alkalinity Hardness, Residual chlorine, Chlorides, Dissolved oxygen, BOD, COD, Nitrogen, Oil and Grease.

Environmental Microbiology, Ecology: Basic concepts scope of ecology related to humanity, classification of Ecology Models, Ecosystems, Energy flow in Ecosystems, Universal model of Ecology Energy flow, Principles pertaining to limiting factors, Leigbig's law of the minimum shelferd's law of tolerance. Limnology: Fresh Water environment, Ecological classification of fresh water organisms.

Microbiology: Basic concept, characterization and classification of microorganisms. Morphology and Structure of Bacterial Cells, Bacterial metabolism, Energy production and bacterial growth, microorganism other than bacteria important in Biological treatment system.

Control of microorganisms by physical chemical agents. Path agonic microorganisms. Microbiology of domestic water and sewage.

References:

1. Chemistry for Environmental Engineering, Clair N.Sawyer, Perry Mccarty, Gene F. Parkin, McGraw Hill Inc. New York.
2. Microbiology by M.J. Pelczar, R.D. Reid, Tata McGraw Hill Inc., 1993.

Subject : Advanced Wastewater Treatment

Quality characteristics of wastewaters. Physical, chemical & Biological water quality parameters. Water quality requirement; Stream Standards, Potable water standards and waster water Influent standards, Physico- chemical processes involved in Waste water treatment;

Sedimentation, Coagulation & Flocculation, various types of setting, settling tank; principle and design, Grit chamber; principle, types and design aspects. Filtration: Theory, methods of filtration and their modified forms.

Disinfections: Objective and different methods.

Organic impurities of waste water, composition of waster water, biological treatment, aerobic and anaerobic processes. Microorganisms in biological treatment and their metabolic kinetics. Kinetics of plug flow and complete mix reactors.

ASP and its modifications, aeration, objective and methods, design of aeration devices.

Bio-filters: various types, Trickling filters and their design. Sludge handling and disposal; Sludge types and composition. Various methods of sludge treatment. Sludge digestion tanks. Disposal of sludge. Tertiary treatment of wastewater: objective and methods.

References:

1. Water and waste water Engg. By G.M. Fair, J.C. Geyer and D.A., Okun Vol. I & II John Wiley & Sons Inc New York, 1966
2. Manual on water supply & Treatment by Govt. of India, Ministry of Works and Housing.
3. Manual on Sewerage and Sewerage Treatment by Govt. of India, Ministry of Works and Housing
4. Unit Operation of Sanitary Engg. By L.G. Rich John Wiley & Sons Inc New York, 1966

Subject : Air Pollution & Control

Introduction, Atmospheric composition, Origin of air pollution, Global implications of air pollution, Classification of air pollutants, Particulars, Hydrocarbons and Gaseous air pollutants. Sources of air pollutants and their health effects. Meteorological aspects of air pollution, Influence of Meteorological aspects on Air Quality: Lapse rate and Dispersions, Wind and Dispersions, Moisture and dispersion, modeling.

Air Pollution sampling: Ambient and stack sampling, Ambient Air Quality Monitoring, Engineered systems of air pollution Control: Atmospheric cleansing process, approaches to contaminant control. Control devices for particulate contaminant and gaseous contaminants.

References:

01. Air Pollution by Henry C. Parkin, Mc Graw Hill Publishers, New York, 1977.
2. Instrument Engineers Handbook, Vol. I & II by Liptak, B.G., Philadelphia, Published by Chilton Book Company, 1972.
3. Environmental Engineering by H.S. Peavy, D.R. Rowe & G.Tchobanoglous

Subject : Environmental Pollution & Management

Water Pollution: Components of water, hydrological cycle and water budget equation, Effects of Environmental Pollution on components of hydrological cycle.

Classification of water pollutants and their sources, Types of water pollution, Sources of water pollution and effect of polluted waters on environment and health. Consequences of polluted water disposal on land, rivers and lakes.

Self purification of river and impoundments. Do sag curve and self purification models. Eutrophication of lakes; Ground water pollution, Causes and consequences, Artificial recharging of ground waters.

Noise Pollution: Noise & Noise pollution definitions Physical parameters of Noise pollution, Sources and health effects of Noise pollution.

Strategies for noise pollution control; Control at sources and control at path. Case studies of Noise Pollution and its control.

Thermal Pollution: Sources of thermal discharges, Global heat Balance, effects of disposal of heated effluents on stream control of thermal pollutants and methods.

References:

1. Advances in Environmental Science and Technology by R.K. Trivedy Ashish Publishers, 1995.
2. Air Pollution by Ashok Kumar Srivastava, Ashish publishers, 1991.
3. Environmental concerns and strategies by T.n. Khoshoo, Ashish Publishers, 1991.
4. Advances in Environmental Science by A.K. Tripathy, A.K. Srivastava and S.N. Pandey, Ashish Publishers, 1993.
5. Environmental Engineering – An overview by Baljeet Kapoor, Khanna Publishers, 4th Edition, 1996.

IRRIGATION & HYDRAULICS ENGINEERING

Subject: COMPUTER PROGRAMMING & OPTIMIZATION TECHNIQUES

Software Engg., Software Development Language `C', RDBMS Civil Engg. Software Packages, Fundamentals of optimization, Statistical optimization, Linear Programming, Dynamic Programming.

REFERENCES:

1. Software Engineering – Roger Pressman.
2. Software Development in `C' – Yashwant Kanetkar.
3. Operations Research – D.S.Heera & P.K.Gupta
4. Optimisation Theory & Applications – S.S.Rao

Subject : Advanced Hydrology

Introduction, Precipitation, Isohytal method, Area depth duration and intensity duration frequency curves, Design applications, Standard Project Storm, Water Losses, Measurement and estimation of evaporation and transpiration. Runoff, Rainfall runoff relationship Hydrograph, Design Flood, Unit Hydrograph, Instantaneous Unit Hydrograph, Flood Routing, Flood Forecasting, Hydrologic Models.

References:

1. K.N. Mutreja Applied Hydrology; Tata – Mc-Graw Hill.
2. Linsley, Kohler, Phalus 'Hydrology for Engineers' Mc-Graw Hill.
3. Handbook of Applied Hydrology – V.T.Chow

Subject : Fluid Mechanics & Open Channel Flow

Kinematics of flow, General Curvilinear Orthogonal System of Co-ordinates, Hydrodynamics, Boundary Layer Theory, Derivation of Prandtl's equations thickness parameters, Karman's equation, Laminar Flow, Derivation of Navier- Stokes Equation and Properties, Turbulent Flow, Hydraulics of Open Channel Flow, Transitions, Rapidly Varied Flow, Wave Motion, Sediment Transportations, ,Incipient motion, Total load equation,Hydraulic Transients.

References:

1. H. Schlichting "Boundary Layer Theory" Mc-Graw Hill.
2. Hinze 'Turbulence', Mc-Graw Hill.
3. H. Rouse "Advanced Fluid Mechanics"
4. V.L. Streeter " Hand book of Fluid Dynamics"
5. V.T. Chow. Open Channel Hydraulics

Subject : Water Resources & Planning

Project Planning, Elements of Water Resources Development, Issues in Planning, Planning Process Data Needed for Planning, Project analysis, Integrated River Basin Development, Water Resources Planning, Systems Engg., Linear Programming, Dynamic Programming Earth & Concrete Dams, Groundwater Hydraulics, Projects Economics, Comparison of Alternatives.

References:

1. Hall and Dracup, Water Resources Systems Engineering, Mc-Graw Hill.
2. James – Lee – Economics of Water Resources Planning, Willey.
3. Linsley and Franzini – Water Resources Engineering, Mc-Graw Hill.

Subject: Geotechnical/Geo-environmental Engineering

Origin and Classification of soils, and Phase Relationships, Clay minerology, Diffuse double layer, Compaction Effective Stress Principle, Permeability, Seepage pressure, Quick sand condition, Pheratic lines, Flow nets, Compressibility, Terzaghi's Consolidation Theory, Shear Strength, Shear Strength Parameters – total stress and effective stress, Mohrs Circle, Failure Envelope, Stress path
Site Exploration: Methods of soil exploration with relative merits and demerits, Depth and spacing of bore holes, Standard penetration tests, Plate load tests, Static cone penetration tests etc

Bearing Capacity: Bearing capacity theories, corrections for size, shape, depth, eccentricity of loading, water table etc., Presumptive bearing capacities, Codal provisions

Lateral earth Pressure: Rankine's and Coloumb's theories, Earth pressure computation in different soils and surcharge load, Rebhnann's and Culmann's construction. Design considerations of earth retaining structures.

Foundations: Shallow Foundations, Pile Foundations (including under-reamed piles), Cassion and Well foundations; Design considerations, Codal provisions, Layered soils. Choice of shear strength parameters, Total and differential settlement. Stress distribution, Consolidation settlement in clays (with correction factors), Immediate settlement, Settlement in sands

Slope Stablility: Finite and infinite slopes, Critical failure surface, factor of safety, Causes of failure in earthen dams and remedial measures.

Ground Improvement: Mechanical soil stabilization, Mixing additives, Compaction piles, compaction by dynamic loads, Pre-loading using sand drain, Reinforced soil

Soil Dynamics: Engineering problems involving soil dynamics; Dynamic loading, Role of inertia; Theory of Vibrations, Types of machine foundations, Design criteria for machine foundations, Codal provisions.

Geo-Environmental Engineering: Landfills, Slurry Pond, Liners and Covers, Tailing dam