STRUCTURAL ENGINEERING

Paper-I

1. Advanced Structural Analysis
2. Analysis of Folded Folded Plates & Shells
3. Advanced Concrete Technology
4. Building Construction Management
5. Experimental Stress Analysis
6. Finite Element Methods in Structural Engineering
7. Fracture Mechanics
8. Prestressed Concrete & Steel Structures
9. Mechanics of Composite Materials and Structures
10. Construction Management

Paper-II

1. Advanced Steel Structures
2. Advanced Structural Design
3. Artificial Neural Networks and Fuzzy Logics
4. Advanced Bridge Engineering
5. Low cost Housing Techniques
6. Maintenance and Rehabilitation of Structures
7. Stability of Structures
8. Structural Dynamics
9. Theory of Elasticity and Plasticity
10. Mechanical Vibrations

Soil Mechanics & Foundation Engineering

Paper-I

1. Ground Improvement Techniques
2. Soil Dynamics & Machine Foundation
3. Foundation Engineering.
4. Earth Retaining Structures
5. Design with Geo-synthetics
6. Soil- Structure Interaction
7. Geotechnical Earth Quake Engineering

Paper-I I

1. Pavement analysis and Design
2. Numerical Methods in Geotechnical Engineering
3. Advanced Soil Mechanics
4. Earth Dams
5. Geo-Environmental Engineering
6. Theory of Elasticity
7. Remote Sensing and GIS

Environmental Engineering & Management, Water Resources Engineering, Engineering Geology, Remote Sensing &GIS

Paper -I

1. Environmental Chemistry
2. Industrial Waste Treatment
3. Principles and Applications of Remote Sensing, GIS
4. Principles of Geomorphology

Paper - II

1. Air Pollution & Control
2. Physico-Chemical Processes for Water Quality Control
3. Structural Geology& Petrology
4. Environmental Impact Assessment of Water Resources Projects

ADVANCED STRUCTURAL ANALYSIS

1. **INDETERMINACY-** Determination of static and kinematic indeterminacies of two-dimensional and three-dimensional portal frames, pin jointed trusses and hybrid frames-coordinate systems –structural idealization.

2. **INTRODUCTION TO MATRIX METHODS OF ANALYSIS**-Flexibility and stiffness matrices-Force displacement relationships for axial force, couple, torsional moments – stiffness method of analysis and flexibility method of analysis.

3. **ANALYSIS OF CONTINUOUS BEAMS**- stiffness method and flexibility method of analysis –continuous beams of two and three spans with different end conditions-internal hinges.

4. **ANALYSIS OF 2-DIMENSIONAL AND 3-DIMENSIONAL PINJOINTED TRUSSES** - stiffness and flexibility methods-computation of joint displacement and member forces.

5. **ANALYSIS OF TWO DIMENSIONAL PORTAL AND GABLE FRAMES** – stiffness and flexibility method of analysis of 2D portal frames with different end conditions-plotting of bending moment diagrams

6. **TRANSFORMATION OF CO-ORDINATES** - Local and Global co-ordinate systems-transformation of matrices from local to global coordinates of element stiffness matrix-direct stiffness method of analysis-assembly of global stiffness matrix from element stiffness matrices –static condensation-sub-structuring.

7. **EQUATION SOLUTION TECHNIQUES -** solution of system of linear algebraic equations-direct inversion method-gauss elimination method-Cholesky method-banded equation solvers-frontal solution technique.

TEXT/REFERENCE BOOKS:

1. Coates, R.C., Couties, M.G., and Kong, F.K., Structural Analysis, ELBS.
2. McGuire, W.,and Gallagher, R.H., Matrix Structural analysis, John Wiley and sons.
3. John L.Meek., Matrix Strucstural Analysis, Mc Graw Hill Book company.
4. Structural Analysis by Pundit & Gupta
5. Structural Analysis by C.S.Reddy.
6. Structural Analysis – R.C. Hibbeler
7. Intermediate Structural Analysis – C.K.Wang

ANALYSIS OF FOLDED PLATES AND SHELLS

1. **Equations of equilibrium :** Introduction, classification, stress derivation of stress Resultants, Principles of membrane theory and bending theory. (Design Not included)

2. **Cylindrical shells:** Derication of governing DKJ equation for bending theory, details of Schorer's theory Applications to the analysis and design of short shells and long shells. Introduction of ASCE manual co-efficients for design. (Design Not included)

3. **Introduction to shells of double curvature**: (other than shells of revolution:) Geometry and analysis of elliptic paraboloid, rotational parabolid and hyperbolic paraboliod shapes by membrane theory. (Design Not included)

4. **Folded Plates:** Folded plate theory, plate and slab action, Whitney's theory, Simpson's theory for the analysis of different types of folded plates (Design is not included)

5. **Shells of double Curvature**-Surfaces of revolution .Derivation of equilibrium equations by membrane theory, Applications to spherical shell and rotational Hyper boloid(Design Not included)

TEXT / REFERENCE BOOKS:

1. Design and construction of concrete shell roofs by G.S. Rama Swamy – CBS Publishers & Distributors, 485, Jain Bhawan Bhola Nath Nagar, shahotra, Delhi.
2. Fundamentals of the analysis and design of shell structures by Vasant S.Kelkar Robert T.Swell – Prentice hall, Inc., englewood cliffs, new Jersy – 02632.
3. N.k. Bairagi, Shell analysis, Khanna Publishers, Delhi, 1990.
4. Billington, lthin shsell concrete structures, Mc Graw Hill Book company, New york, St. Louis, Sand Francisco, Toronto, London.
5. ASCE Manual of Engineering practice No.31, design of cylindrical concrete shell roofs ASC, Newyork.

ADVANCED CONCRETE TECHNOLOGY

1. Cements and Admixtures: Portland cement – Chemical composition - Hydration, setting and finenecess of cement – structures of hydrated cement – mechanical of cement gel Necgabucak strength if cent gek – water held in hydrate cement paste – Heat of hydration of cement – Influence of compound composition on properties of cement – tests on physical properties of cement – I.S. specifications – Different types of cements – Admixtures.

2. Aggregates: Classification of aggregate – particle shape and texture – Bond, strength and other mechanical properties of aggregate specific gravity, Bulk density, porosity, absorption and moisture in aggregate – soundness of aggregate – Alkali – aggregate reaction I Thermal properties – sieve analysis – Finensess modulus – grading curves – grading quirements – practical grading – Road note No. grading of fine and coarse aggregates gap graded aggregate – maximum aggregate size.

3. Fresh concrete: Workability – factors affecting workability – measurement of workability by different tests – Effect of time and temperature on workability – segregation and bleeding – mixing and vibration of concrete – quality of mixing water.

4. Hardened Concrete: Water/cement ratio-Abram's law – Gel space ratio – effective water in mix – Nature of strength of concrete – strength in tension and compression-Griffith's hypothesis – factors affecting strength – autogeneous healing –Relation between compression and tensile strength – curing and maturity of concrete Influence of temperature on strength – Steam curing – testing of Hardened concrete – compression tests – tension tests – factors affecting strength – flexure tests – splitting tests – Non destructive testing methods.

5. Elasticity, Shrinkage and Creep: Modulus of elasticity – dynamic modulus of elasticity – poission's ratio – Early volume changes – swelling – Drying shrinkage - Mechanism of shrinkage – factors affecting shrinkage – Differential shrinkage – moisture movement carbonation shrinkage-creep of concrete – factors influencing creep – relation between creep and time – Nature of creep – Effect of creep.

6. Mix Design: Proportioning of concrete mixes by various methods – fines modulus, trial and error, mix density, Road Note.No. 4, ACI and ISI code methods – factors in the choice of mix proportions – Durability of concrete – quality control of concrete – Statistical methods – High strength concrete mix design

7. Special concrete's: Light weight cibcretes – light weight aggregate light weight aggregate concrete- Mix design – Cellular concrete No- fines concrete – High density concrete – Fiber reinforced concrete – Different types of fibers - factories affecting properties of FRC – Applications polymer concrete – types of polymer concrete properties of polymer concrete applications- High strength concrete, High Performance concrete, Self Compacting Concrete.

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Subject Code:

BUILDING CONSTRUCTION MANAGEMENT

Unit-I:
Introduction – Types constructions public and private contract management – scrutinizing tenders and acceptance of tenders, contracted, changes and terminating of contract – subcontracts construction organizations – organizational chart-Decentralization payrolls and records – organization chart of a construction company.

Unit-II:
Construction practices – Times Management – bar chart, CPM, PERT – Progress report

Unit –III:
Resources management and inventory- Basic concepts equipment management, material management inventory control.

Unit-IV:
Accounts management – Basic concepts, Accounting system and book keeping, depreciation, Balance sheet, profit and loss account, internal auditing. Quality control by statistical methods, sampling plan and control charts, safety requirements.

Unit-V:
Cost and Financial Management – Cost volume relationship, cost control system, budget concept of valuation, cost of equity capital management cash. Labor and industrial; laws – payment of wages act. Contract labor, workmen's compensation, insurance, industrial disputes act.

TEXT / REFERENCE BOOKS:

1. Construction Management and planning by B.Sengupata and H.Gula(Tata Mcgraw Hill)
2. Construction Management by Atkinson(Elseverir)
3. in principle land practice by EEC beech(Longman)
4. Robert Schultheis, Mary Summer (1999)" management Information Systems – The Mangament View. " TATA mc Graw Hill Edition, New Delhi.
5. Kwakye, A.A. (1997), "construction Project Administration Adisson Wesley Longman, London
6. Keith Davis, Human Behaviour at work, Mc Graw Hill, USA, 1981.
7. Sehroeder, R.g., Operations Mangement, Mc Graw Hill, USA 1982.
8. james C.Van Horne, Financial Management and policy, prentice Hall of India Pvt. Ltd,, 4th Ed., New Delhi., 1979
9. Varshney R.L and Maheswari, K.l., managerial Economics, Sultan Chand, 1975
10. Frank Harrison, E., The Managerial Decision making process, Houghton Mifflin Co., Boston, 1975.

EXPERIMENTAL STRESS ANALYSIS

1. **PRINCIPLES OF EXPERIMENTAL APPROACH :-**
   Merits of Experimental Analysis Introduction, uses of experimental stress analysis advantages of experimental stress analysis, Different methods –Simplification of problems.

2. **STRAIN MEASUREMENT USING STRAIN GAUGES :-**
   Definition of strain and its relation of experimental Determinations Properties of Strain-Gauge Systems-Types of Strain Gauges –Mechanical, Acoustic and Optical Strain Gauges.

3. **ELECTRICAL STRAIN GAUGES :-**
   Inductance strain gauges – LVDT – Resistance strain gauges – various types –Gauge factor – Materials of adhesion base etc…

4. **STRAIN ROSETTES** :-
   Introduction – The three element Rectangular Rosette – The Delta Rosette – Corrections for Transverse Strain Gauge.

5. **NON – DESTRUCTIVE TESTING :-**
   Ultrasonic Pulse Velocity method –Application to Concrete . Hammer Test – Application to Concrete.

6. **BRITTLE COATING METHIDS :-**
   Introduction –Coating Stress – Failure Theories –Brittle Coating Crack Patterns – Crack Detection –Types of Brittle Coating – Test Procedures for Brittle Coating Analysis – Calibration Procedures – Analysis of Brittle Coating Data.

7. **THEORY OF PHOTOELASTICITY** :-
   Introduction –Temporary Double refraction – The stress Optic Law –Effects of stressed model in a polariscope for various arrangements – Fringe Sharpening. Brewster's Stress Optic law.

8. **TWO DIMENSIONAL PHOTOELASTICITY :-**
   Introduction – Isochramic Fringe patterns- Isoclinic Fringe patterns passage of light through plane Polariscope and Circular polariscope Isoclinic Fringe patterns – Compensation techniques – Calibration methods – Separation methods – Scaling Model to prototype Stresses – Materials for photo – Elasticity Properties of Photoelastic Materials.

Reference Books :-

1. Experimental stress analysis by J.W.Dally and W.F.Riley
2. Experimental stress analysis by Dr.Sadhu Singh.

Subject Code:

FINITE ELEMENT METHODS IN STRUCTRAL ENGINEERING

1. Introduction: Review of stiffness method- displacement field - Integral form-differential form - "Rayleigh-Ritz method" of functional approximation - variational approaches - weighted residual methods- concept of FEM.

2. Bar and torsional elements: Degree of freedom –simple element- higher order element-nodal displacement vector- shape functions- FE formulation-discrimination- stiffness matrix of element- element nodal load vector-assembling- total potential in terms of FEM formulation- boundary conditions- strain, stress and force in element-reaction-torsional element. trusses-Iso-parametric element. –natural coordinates.

3. Beam, frame and grid elements: Degree of freedom - displacement vector - simple element- higher order element-nodal displacement vector - shape functions-discrimination- stiffness matrix of element- element nodal load vector-assembling-total potential in terms of FE formulation- boundary conditions- strain, stress and forces in elements-reactions- frame element-Grid element-Beams - frames- Grid structures. Iso-parametric element –natural coordinates.

4. Membrane element: 2 Dimensional structures- Plane stress-plane strain- triangular elements-CST element-LST element-rectangular elements-Legrangian family of elements-Serendipity family of elements Shape functions – nodal displacement vector-FEM formulation-element stiffness matrix- element nodal load vector due to body forces, traction and concentrated loads- Iso-parametric element- Area coordinates- strain vector and stress vector in element.

5. Axisymmetric solids: Modelling as 2D problem: stress-strain relations- material stiffness matrix-dof - Triangular element- rectangular element-shape functions-Displacement function- FE formulation -stiffness matrix of element- nodal loads- strain vector, stress vector in elements- reactions. Iso-parametric element-Area coordinates.

6. 3 Dimensional stress analysis: dof – types of elements- simple elements – higher order elements-displacement function- shape functions- nodal displacement verctor- Nodal load vector- stiffness matrix of element- FE formulation – volume coordionates-isoparametric elements- strain vector and stress vector in element.

7. Plate structures & shell structures: dof- displacement field – nodal displacement vector-shape function- Finite Element Formulation of plate structures- types of elements- strain vector and stress vector in element-types of elements.

8. Development of simple programs for simple structures- Introductio of FEM package(only class work)

REFERENCES:

1. Concepts and applications of Finite Element Analysis – Robert D. Cook, Michael E Plesha, John Wiley & sons Publications
2. An introduction to the Finite Element Method- J N Reddy, Tata Mc Graw Hill.
3. A first course in the Finite Element Method – Daryl L. Logan, Thomson Publications.
4. Introduction to Finite Elements in Engineering- Tirupati R. Chandrupatla, Ashok D. Belgunda, PHI publications
5. Fundamentals of Finite Element Analysis- David V. Hutton, Tata McGraw-Hill
6. Finite Element Analysis – S.S. Bhavikatti, New age International publishers
7. Finite element Analysis- Theory and programming – C.S. Krishna Murthy, Tata Mc Gra Hill.
8. Finite element Analysis – P.Seshu, PHI
9. Finite element method – O.C. Zeinkiewicz, Tata Mc Gra Hill,1988
10. Energy methods and Finite Element Methods - Huges

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FRACTURE MECHANICS OF CONCRETE STRUCTURES

1. Introduction: Fundamentals of elastic and plastic behaviour of materials- stresses in a plate with a hole – Stress Concentration factor- modes of failure- Brittle fracture and ductile fracture- history of fracture mechanics-Griffiths criteria of cracks- mode I, mode II and mode III failure.

2. Principles of Linear Elastic Fracture Mechanics: SOM vs Fracture Mechanics -stressed based Criteria for fracture- Stress Intensity Factors- K_I K_{II} and K_{III} – Critical stress Intensity Factors, K_{Ic} K_{IIc} and K_{IIc} – crack tip plastic zone – Erwin's plastic zone correction -Critical crack length-Load carrying capacity of a cracked component-Design of components based on fracture mechanics.

3. Griffith's criteria- Criteria for crack propagation -Energy release rate , G_I G_{II} and G_{III} - Critical energy release rate G_{Ic} , G_{IIc} and G_{IIIc} – surface energy - R curves – compliance- J-Integrals:

4. Crack Tip Opening Displacements (CTOD)- Crack Mouth Opening Displacement (CMOD)- Critical crack tip opening displacement ($CTOD_c$) –critical Crack Mouth Opening Displacement ($CMOD_c$)-Determination of fracture parameters.

5. Experimental determination of fracture parameters- K_{Ic} , G_{Ic}, $CTOD_c$ and critical J-Integral.-for brittle and quasi brittle materials like concrete and rock- Specimen geometry .

6. Nonlinear Fracture Mechanics for mode I quasi- brittle fracture(Concrete): General quasi-brittle fracture-Ficticious crack approach - Hillerborg's Fictitious crack model-Bazanth's crack band model- Effective elastic crack approach-Two Parameter model-Bazanth' Size effect model-effective crack model-

7. Applications of Fracture Mechanics to Concrete structures: Size effect on nominal strength-Tension ,Bending, Shear and torsion of RRC members-Concrete dams-Interfacial fracture mechanics-

8. Fatigue and life estimation of structures based on fracture and fatigue

REFERENCES

1. Engineering Fracture Mechanics- S.A. Meguid, Elsevier Applied Science Publications.
2. Elementary engineering fracture mechanics – David Broek – Sijthoff & Noordhoff – Alphenaan den Rijn – Netherlands.
3. Elements of Fracture Mechanics – Prasanth Kumar, wiley Eastern Publications
4. Fracture Mechanics: Fundamentals and applications – T. L. Andrason, PhD, *CRC* publications
5. Fracture Mechanics of Concrete: Applications of fracture mechanics to concrete, Rock, and other quasi-brittle materials, Surendra P. Shah, Stuart E. Swartz, Chengsheng Ouyang, John Wiley & Son publications.
6. Fracture mechanics of concrete structures – Theory and applications – Rilem Report – Edited by L. Elfgreen – Chapman and Hall – 1989.
7. Fracture mechanics – applications to concrete – Edited by Victor, C. Li, & Z.P. Bazant – ACI SP 118.
8. Fracture and Fatigue Control in Structures - John M.Barsom- Senior consultant United states Steel corporation & Stanley T.Rolfe- Ross H.Forney Professor of Engineering University of Kansas. & Stanley T.Rolfe- Ross H.forney Professor of Engineering-University of Kansas

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PRESTRESSED CONCRETE AND STEEL STRUCTURES

1. **INTRODUCTION:** Development of prestressed concrete –Advantages and Disadvantages of PSC over RCC –General principles of pre-stressing-pre tensioning and post tensioning –Materials used in PSC-high strength concrete –High tension steel-Different types /methods/systems of prestressing.

2. **Losses of prestress**: Estimation of the loss of prestress due to various causes like elastic shortening of concrete ,creep of concrete, shrinkage of concrete, relaxation of steel, slip in anchorage, friction etc.

3. **Flexure:** Analysis of sections for flexure in accordance with elastic theory-Allowable stresses-Design criteria as per I.S code of practice –Elastic design of Beams (rectangular, I and T sections) for Flexure –Introduction to partial prestressing.

4. **Shear, bond, Bearing and Anchorage:** shear in PSC beams –Principal stresses –Conventional elastic design for shear-transfer of prestress in pretensioned members-transmission length –Bond stresses-bearing at anchorage –Anchorage zone stresses in post-tensioned members-Analysis and design of end blocks by Guyon, Magnel and approximate methods –Anchorage zone reinforcements.

5. **Deflections:** Introduction-Factors influencing deflections-short term and long term time deflections of uncracked and cracked members.

6. **Composite Construction:** Types of composite construction-stress distribution in composite sections-analysis of stresses-Differential shrinkage-Design of simple composite sections.

7. **Statistically indeterminate structures**: Introduction –advantages and disadvantages of continuity –Layouts for continuous beams-primary and secondary moments –Elastic analysis of continuous beams-Linear transformation-Concordant cable profile-Design of continuous beams.

1. **Circular prestressing**: Introduction –Circumferential prestressing Design of Prestressed concrete tanks –vertical prestressing in tanks-Dome prestressing.
2. **Introduction to prestressing of steel structures.**

REFERENCE BOOKS:

- Prestressed Concrete by S.Krishnam raju
- Prestressed Concrete by S.Ramamrutham
- Research materials on prestressing steel structures

MECHANICS OF COMPOSITE MATERIALS AND STRUCTURES

1. **Basic concepts and characteristics:** Geometric and Physical definitions, natural and man-made composites, applications, types and classification of composites, lamina and laminate characteristics and configurations, constituent materials and properties, properties of typical composite materials.

2. **Coordinate transformations:** Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness modulus, off - axis compliance.

3. **Elastic behavior of unidirectional composites**: Elastic constants of lamina, relation ship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

4. **Strength of unidirectional lamina:** Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micromechanical predictions of elastic constants.

5. **Analysis of laminated composite plates**: introduction, thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, bending and vibration analysis of laminated composite plates using finite element method.

Text Books:

1. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press, 1994.
2. B. D. Agarwal and L. J. Broutman, Analysis and performance of fibre Composites, Wiley-Interscience, New York, 1980.

Reference:

1. R. M. Jones, Mechanics of Composite Materials, Mc Graw Hill Company, New York, 1975.
2. L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969.

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Subject Code:

CONSTRUCTION MANAGEMENT

1. Significance of Construction Management, Objectives and Functions of Construction management. The Construction Industry and stages in Construction. Construction Team Owner, Engineer and Architect.

2. Bar Charts, Times Estimates, PERT Network Analysis, Critical Path Method, Criticality Index, Project Cost Analysis and Updating, Costs. Direct, Indirect and Total Project costs, Optimization of Cost through Network Construction.

3. Methods of Updating, Updating Flow Chart etc. Resource Management in Construction Industry Basic Concepts, Equipment management, Materials Management.

4. Requirements of LP Problem, Methodology of OR and limitation of LP model. Linear Programming. Simplex Method, Degeneracy in Simplex Method, Duality and Post Optimality analysis. Application of OR in Construction Industry.

5. Sustainability-Various definitions of sustainable development and sustainable construction Strong versus weak sustainability, Built environment.

Suggested Reading:

1. Gahlot, P.S. and Dhir. B.M. (1992). " Construction Planning and Management " Wiley Eastern Limited, New Delhi.

2. Principles of Sustainable Construction
Charles J Kilbert.

3. Seetharaman, S.(1997). " Construction Engineering and Management. "Umesh Publications, New Delhi.

4. Vohra, N.D. (1990). " Quantitative Techniques in Management. " Tata MeGraw-Hill Publishing Company Limited, New Delhi.

5. Srinath, L.S. (1989). " PERT and CPM Principles and Applications." Affiliated East-West Press PVT LTD, New Delhi.

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ADVANCED STEEL STRUCTURES

1. Design and analysis of transmission towers

2. Analysis and design of industrial buildings –design of knee braced trusses, stanchions, wind bracing.

3. Analysis of multistoried frames under lateral loading using approximate methods such as cantilever method, portal method and factor method.

4. a) Unsymmetrical bending
   b) Shear center for simple sections like L, C, I and T.

5. Theorems of plastic analysis, applications to the cases of rectangular portal frames, gable frames etc.

6. General methods of plastic design: Combining mechanisms methods, plastic moment distribution method. Application to few cases of frames including multi – storied. Estimation of deflections in few typical cases.

7. Principles of optimization in structural design. Application to some simple cases – minimum weight design.

TEXTS/REFERENCE BOOKS:

1. Plastic analysis of structures by B.G.Neal
2. Steel Skeleton Vol.I and II by Baker
3. Design of steel structures by Vazarani and Ratwani
4. Strength of materials (Vol-II)) by Timoshenko.
5. Steel Tower by Shantha Kumar

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ADVANCED STRUCTURAL DESIGN

1. Deflection of Reinforced concrete beams and Slabs: Introduction- Short-term Deflection of beams and Slabs- Deflection due to Imposed loads- Short- term deflection of beams due to applied loads- Calculation of deflection by IS 456- Calculation of deflection by BS 8110- Deflection calculation by Euro code- ACI Simplified Method- Deflection of continues beams by IS 456- Deflection of Cantilevers- Deflection of Slabs

2. Estimation of Crackwidth in Reinforced Concrete Members: Introduction- Factors affecting Crackwidth in beams- Mechanism of Flexural cracking- Calculation of crack widths- Simple Empirical method- Estimation of Crackwidth in beams by IS 456 of BS 8110- Shrinkage and Thermal Cracking

3. Design of Reinforced Concrete Deep Beams: Introduction- Minimum Thickness- Steps of Designing deep beams- Design by IS 456- Design according to British Practice- ACI Procedure for design of deep beams- Checking for local failures- Detailing of deep beams

4. Shear in Flat Slabs and Flat Plates: Introduction- Checking for One-way (wide beam) shear- Two-way (Punching) shear- Permissible punching shear- Shear due to Unbalanced Moment (Torsional moments)- Calculation of j values- Strengthening of column areas for moment transfer by torsion which produces shear- Shear Reinforcement Design- Effect of openings in Flat slabs- Recent Revisions in ACI 318- Shear in Two – way Slabs with beams.

5. Design of Reinforced Concrete Members for Fire Resistance: Introduction- ISO 834 standard heating conditions- Grading or classifications- Effect of High temperature on steel and concrete- Effect of high temperatures on different types of structural members- Fire resistance by structural detailing from Tabulated data- Analystical determination of the ultimate bending moment capacity of reiforced concrete beams under fire- Other considerations

6. Design of plain concrete walls: Introduction- Braced and Unbraced walls- Slenderness of walls- Eccentricities of vertical loads at Right angles to wall- Empirical design method for plane concrete walls carrying axial load- Design of walls for In-plane Horizontal forces- Rules for detailing of steel in concrete walls

7. Design of Shear walls: Introduction- Classification of shear walls- Classification according to behavior- Loads in shear walls- Design of Rectangular and flanged shear walls- Derivation of formula for moment of Resistance of Rectangular shear walls-

TEXT/REFERENCE BOOKS:

1. P.Purushothaman- Reinforced concrete Structural Elements: Behaviour- analysis and Design- TATA Mc Graw Hilll.
2. C.E. Reynolods and J.C. Steedman- Reinforced Concrete Desigers Hand bood- A view point publication.
3. Limit State Design of Reinforced Concrete Structures by P.Dayaratnam- oxford & IBH Publishers- 2004 edition.
3. Advanced RCC by N.Krishna Raju - CBS Publishers & Distributors.
4. Reinforced cement concrete structures – Devadas Menon

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ARTIFICIAL NEURAL NETWORKS AND FUZZY LOGICS

Introduction: A New Breed of Processor: The Brain; The Engineering of the Brain; A world of Fuzzy Thinking; Crisp versus Fuzzy Logics; Fuzzy and Neural Networks; Where Are Fuzzy Neural Networks Headings; Objectives;

Biological Neural Networks: The Axon: A Transmission Line; The Synapse; The Synapse; A Biocomputer Types of Synapses; The Developing Neuron: Forming Networks; Neuronal Specialization; The Cell's Biological Memory; Weighting Factor; Factors Affecting Potassium-ion Flow; Firing, in a Nutshell; Neuronal; Diversity; Specifications of the Brain; The Eye's Neural Network; Retina Structure; Rods and Cones; From photons to Electrons; A Photochemical Chain Reaction Organization and Communication of the Retina Neural Network; Image Processing in the Retina; Visual Pathways;

Artificial Neural Networks: Concepts: Neural Attributes; Artificial Neural Networks; Same Mathematics Again; Modeling; Basic Model of a Neuron; Learning in Artificial Neural Networks; Supervised Learning; Unsupervised Learning; Reinforced Learning; Competitive Learning; The Delta Rule; Gradient Descend Rule; Hebbian Learning Characteristics of ANNs; Important ANN Parameters; Artificial Neural Network Topologies; Modeling ANNs; ANN Learning and Program; Learning Algorithms; Discrimination Ability; Linearly Separable ANNs; Multilinear ANNs; Nonlinear Separable ANNs; ANN Adaptability; The Stability-Plasticity Dilemma;

Neural Network Paradigms: Mc Culloch- Perception; The Perception; ADALINE and MADALINE Models; Winner- Takes- All Learning Algorithm; Back – Propagation Learning Algorithm; Learning with the Back- Propagation Algorithm; Mathematical Analysis; Application; Criticism ; Cerebellum Model Articulation Controller (CMAC); Adaptive Resonance theory (ART) Paradigm; The ART Algorithm; Hopfield Model; Mathematical Analysis; The Hopfield Learning Algorithm Discrete-Time Hopfield Net; Competitive Learning Model ; Memory Type Paradigms; Random Access Memory (RAM); Content Addressable Memory (CAM); Bidirectional Associative Memory (BAM); Content Addressable Memory (TAM); Linear Associative Memory (LAM); Real –Time Models; Linear Vector Quantization (LVQ); self- Organizing Map (SOM); Probabilistic Neural Network (PNN); Radial Basis Function (RBF); Time-Deal Neural Net (TDNN); Cognitron and Neocognitron Models; Simulated Annealing; Boltzmann Machine; Other Paradigms; Restricted Coulomb energy (RCE); Culbertson's Model; Encephalon Project; Cellular Neural Networks; Logicon Projection Networks (LPN); Probabilistic RAM (Pram-256); Neural Acceleration Chip (NAC);

Fuzzy Logic: Propositional Logic; The Membership Function; Fuzzy Logic; Fuzzy Rule Generation; Defuzzification of Fuzzy Logic; Time – Dependent Fuzzy Logic; Crisp Logics; Fuzzy Logics; Temporial Fuzzy Logic (TFL); Time – Invariant Membership Function; Time – Variant Membership Function; Intervals; Semi large Intervals; Interval Operators; Temporial Fuzzy Logic Syntax; Applying Temporial Fuzzy; Operators; Deffuzzification of temporal Fuzzy Logic Example; Applicability of TFL IN Communications Systems; Temporal Fuzzification; Rules and Temporal Defuzzification.

Fuzzy Neural Networks: Fuzzy Artificial Neural Network (FANN); Neural – fuzzy Control; Traditional Control; Neural Control; Fuzzy control; Fuzzy- Neural;

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ADVANCED BRIDGE ENGINEERING

1. Introduction – Classification, investigations and planning, choice of type –economic span length – IRC specifications for road bridges, standard live loads, other forces acting an bridges, general design considerations

2. Design of box culverts – General aspects – Design loads – Design moments, shears and thrusts – Design of critical section.

3. Design of deck slab bridges – Effective width of analysis – working stress design and detailing of deck slab bridges for IRC loading.

4. T-Beam bridges – Introduction – wheel load analysis –B.M in slab – pigaud's theory – analysis of longitudinal girders by courbones theory – working stress design and detailing of reinforced concrete T-beam bridges for IRC loading., Cable stay bridges, suspension bridges and Bow-string arch bridges- Steel Bridges

5. Prestressed Concrete Bridges- General features – Advantages of prestressed concrete bridges - pretensioned prestressed concrete bridges – post tensioned prestressed concrete Bridge decks. Design of post tensioned prestressed concrete slab bridge deck.

6. Bridge Bearings – General features – Types of bearings – forces on bearings basis for selection of bearings– Design principles of steel rocker and roller bearings and its design - Design of elastometric pad bearing – detailing of elastometric pot bearings.

7. Piers and abutments – General features – Bed block – Materials for piers and abutments – types of piers – forces acting on piers- Design of pier – stability analysis of piers – general features of abutments – forces acting on abutments – stability analysis of abutments.

8. Bridge foundations – General Aspects – Types of foundations– Pile foundations – well foundations – caisson foundations.

TEXT/REFERENCES:

1. Essentials of bridges engineering – D.Johnson victor
   oxford & IBH publishes co- Private limited.
2. Design of concrete bridges Mc aswanin VN Vazrani, MM Ratwani, Khanna Publishers
3. Bridge Engineering – S.Ponnuswamy
4. Rowe, R.E., Concrete Bridge Design, C.R. Books Ltd., London, 1962.
5. Taylor F.W., Thomson, S.E., and Smulski E., Reinforced concrete Bridges, John wiley and sons, New york, 1955
6. Derrick Beckett, an Introduction to Structural Design of concrete bridges,surrey. University; press, Henlely – thomes, oxford shire, 1973
7. Bakht. B. and Jaegar, L.G. Bridge Analysis simplified, Mc Graw Hill, 1985
8. Design of Bridges – N.Krishna Raju – Oxfod & IBH
9. Design of Bridge structures – FR Jagadeesh, M.A. jaya Ram – Eastern Economy edition

LOWCOST HOUSING TECHNIQUES

1. a) **Housing Scenario** Introducing- Status of urban housing- Status of Rural Housing-
   b) **Housing Finance:** Introducing- Existing finance system in India- Government role as facilitator- Status at Rural Housing Finance- Impedimently in housing finance and related issues

2. **a) Land use and physical planning for housing:** Introduction- Planning of urban land- Urban land ceiling and regulation act- Effectincey of building bye lans- Residential Densities
   b) Housing the urban poor: Introduction- Living conditions in slums- Approaches and strategies for housing urban poor

3. **Development and adopt on of low cost housing technology:** Introduction- Adoption of innovative cost effective construction techniques- Adoption of precast elements in partial prefabrication- Adopting of total prefabrication of mass housing in India- General remarks on pre cast rooting/flooring systems- Economical wall system- Single Brick thick loading bearing wall- 19cm thick load bearing masonery walls- Half brick thick load bearing wall- Flyash grypsym thick for masonry- Stone Block masonery- Adoption of precast R.C. plank and join system for roof/floor in the building

4. **Alternative building materials for low cost housing:** Introduction- Substitute for scarce materials- Ferrocement- Gypsum boards- Timber substitutions- Industrial wastes- Agricultural wastes

5. **Low cost Infrastructure services:** Introducing- Present status- Technological options- Low cost sanitation's- Domestic wall- Water supply- energy

6. **Rural Housing:** Introduction- traditional practice of rural housing continuous- Mud Housing technology- Mud roofs- Characteristics of mud- Fire resistant treatment for thatched roof- Soil stabilization- Rural Housing programs

7. **Housing in Disaster Prone areas:** Introduction- Earthquake- Damages to houses- Traditional Housesin disaster prone areas Type of Damages and Railways of non-engineered buildings- Repair and restore action of earthquake Damaged non-engineered buildings recommendations for future constructions- Requirement's of structural safety of thin precast roofing units against - Earthquake forces- Status of R& D in earthquake strengthening measures- Floods- cyclone- future safety

TEXT / REFERENCE BOOKS:

1. Building materials for low –income houses – International council for building research studies and documentation's.
2. Hand book of low cost housing by A.K.Lal – Newage international publishers.
3. Properties of Concrete – Neville A.M. Pitman publishing Limited- London.
4. Light weight concrete- Academic kiado- Rudhai .G – Publishing home of Hungarian Academy of Sciences 1963.
5. Low cost Housing – G.C. Mathur
6. Modern trends in housing in developing countries – A.G. Madhava Rao- D.S. Ramachandra Murthy & G.Annamalai

MAINTENANCE AND REHABILITATION OF STRUCTURES

1. **General :** Quality assurance for concrete construction, As built concrete properties, strength, permeability, volume changes, thermal properties, cracking.

2. **Influence on serviceability and Durability:-** Effects due to climate, temperature, chemicals, wear and erosion, design and construction errors, corrosion mechanism, Effects of cover thickness and cracking methods of corrosion protection, inhibitors, resistant steels, coatings cathodic protection.

3. **Maintenance and Repair Strategies:-** Inspection, Structural Appraisal, Economic appraisal, components of quality assurance, conceptual bases for quality assurance schemes.

4. **Materials for Repair: -** Special concretes and mortar, concrete chemicals, special elements for acclerated strength gain, Expansive cement , polymer concrete, sulphur infiltrated concrete, ferro cement, Fibre reinforced concrete.

5. **Techniques for Repair;-** Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning.

6. **Examples of repairs to structures:-** Repairs to overcome low member strength, Deflection, cracking, chemical disruption, weathering, wear, fire, leakage, marine exposure.

TEXT / REFERECNE BOOKS:

1. Dension Campbell, Allen and Harold Roper, Concrete Structures, Materials, Maintenance and Repair, Longman Scientific and Technical, U.K, 1991.
2. RT. Allen and S.C. Edwards, Repair of concrete Structures, Blakie and sons, UK, 1987.
3. MS. Shetty, Concrete Technology – Theory and practice, S.Chand and company, New Delhi, 1992.
4. Santhakumar, S.R. Training course notes on damage assessment and Repair in low cost housing RHDC-NBO Anna University, Madras, July, 1992.
5. Raikar, R.N. learning from failures – deficiencies in Design, construction and service– R & D centre (SDCPL), Raikar Bhavan, Bombay, 1987.
6. N. Palaniappan, Estate Management, Anna Institute of Management, Madras Sep. 1992.
7. F.K. Garas, J.L. Clarke, GST Armer, Structural Assessment, Butterworths, UK April 1987.
8. A.R. Santhakumar, Concrete chemicals – Theory and applications, Indian society for construction Engineering and Technology, Madras. 1993 (In press)

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STABILITY OF STRUCTURES

1. **BEAM COLUMNS:** Differential equation for beam columns –Beam column with concentrated loads –continuous lateral load –couples -beam column with built in ends – continuous beams with axial load –application of Trignometric series –Determination of allowable stresses.

2. **Elastic Buckling of Bars:** Elastic buckling of straight columns –Effect of shear stress on buckling-Eccentrically and laterally loaded columns –energy methods –Buckling of a bar on elastic foundation, Buckling of a bar with intermediate compressive forces and distributed axial loads –Buckling of bars with change in cross section –Effect of shear force on critical load –Built up columns

3. **Inelastic Buckling:** Buckling of straight bars-Double modulus theory –Tangent modulus theory

4. **Mathematical Treatment of Stability Problems:** Buckling problem orthogonality realation –Ritz method-Timoshanko method, Galerkin method

5. **Torsional Buckling :** Pure torsion of thin walled bar of open cross section-Non – Uniform torsion of thin walled bars of open cross section-Torsional buckling –Buckling by Torsion and Flexure.

6. **Lateral Buckling of simply supported Beams:** Beams of rectangular cross section subjected for pure bending

7. **Buckling of simply supported rectangular plates**: Derivation of equation of plate subjected to constant compression in two directions and one direction.

TEXT/REFERNCE BOOKS:

1. Stability of metalic structure by Blunch –Mc Graw hill
2. Theory of Beam columns Vol I by chem & Atsute Mc.Graw Hill.
3. Smitses, Elastic stability of structures, Prentice Hall, 1973.
4. Timoshenko, S., and Gere., theory of Elastic stability, Mc Graw Hill Book company, 1973.
5. Brush and Almorth., Buckling of bars plates and shells, Mc Graw Hill book company, 1975.
6. Chajes, A., Principles of Structural Stability Theory, Prentice Hall, 1974
7. Ashwini Kumar, stability theory of Structures, TATA Mc Graw Hill publishing company Ltd, New Delhi, 1985**.**
8. Elastic stability by Bleaigh.

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STRUCTURAL DYNAMICS

1. **Theory of Vibrations:** Introduction –Elements of a vibratory system – degrees of freedom-continuous systems –lumped mass idealization –Oscillatory motion –Simple harmonic motion –pictorial representation of S.H.M - free vibrations of single degree of Freedom (SDOF) systems –undamped and Damped –Critical damping –Logarithmic decrement –Forced vibrations of SDOF systems-Harmonic excitation –Dynamic magnification factor- Bandwidth.

2. **Introduction to structural Dyanmics:** Fundamental objective of dynamic analysis-types of prescribed loading- Methods of discretization- Formulation of the equations of motion.

3. **Single degree of Freedom System**: Formulation and solutions of the equation of motion - free Vibration response –response to harmonic, periodic, Impulsive and general Dynamic loading –Duhamel integral

4. **Multi Degree of Freedom System:** selections of the degree of freedom –Evaluation of structural property matrices-Formulation of the MDOF equations of motion –Undamped free vibrations-Solution
of Eigen value problem for natural frequencies and mode shapes- Analysis of dynamic response –Normal coordinates –Uncoupled equations of motion –Orthogonal properties of normal modes-mode superposition procedure

5. **Practical vibration analysis:** Stodola method- Fundamental mode analysis –analysis of second and higher modes –Halzer method –basic procedure –transfer matrix procedure

6. **Introduction to Earthquake analysis:** Introduction –Excitation by rigid base translation –Lumped mass approach -SDOF and MDOF system- I.S code methods of analysis.

7. **Continuous system:** Introduction –Flexural vibrations of beams- Elementary case-Equation of motion –Analysis of undamped free shapes of simple beams with different end conditions-principles of application to continuous beams.

REFERENCE BOOKS:

- Dynamics of structures by Clough & Penziem
- Structural dynamics by Mario Paz
- I.S:1893(latest)
" code of practice for earthquakes resistant design of stuctures"

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THEORY OF ELASTICITY AND PLASTICITY

1. INTRODUCTION:
Elasticity –Notation for forces and stresses-Components of stresses –components of strain –Hooke's law.

2. PLANE STRESS AND PLANE STRAIN ANALYSIS:
Plane stress-plane strain-Differential equations of equilibrium- Boundary conditions-Compatability equations-stress function-Boundary conditions.

3. TWO DIMENSIONAL PROBLEMS IN RECTANGULAR COORDINATES:
Solution by polynomials-Saint Venant's principle-Determination of displacements-bending of simple beams-application of Fourier series for two dimensional problems - gravity loading.

4. TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES :
General Equation in polar co-ordinates - stress distribution symmetrical about an axis – Pure bending of curved bars- strain components in polar coordinates-Displacements for symmetrical stress distributions-simple symmetric and asymmetric problems-General solution of two dimensional problem in polar coordinates-Application of the general solution of two dimensional problem in polar coordinates-Application of the general solution in polar coordinates.

5. ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONS: Principle stress - ellipsoid and stress-director surface-Determination of principle stresses-Maximum shear stresses-Homogeneous deformation-principle axis of strain rotation.

6. GENERAL THEROMS:
Differential equations of equilibrium- conditions of compatibility - Determination of displacement-Equations of equilibrium in terms of displacements-principle of superposition-Uniqueness of solution –the Reciprocal theorem.

7. TORSION OF PRISMATICAL BARS:
Torsion of prismatic bars- Elliptical cross section-other elementary solutions-membrane anology-Torsion of rectangular bars-solution of torsional problems by energy method-use of soap films in solving torsionol problems-hydra dyanmical analogies-Torsion of shafts, tubes, bars etc.

8. THEORY OF PLASTICITY:
Introduction- concepts and assumptions -yield criterions.

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Sub. Code:

MECHANICAL VIBRATIONS

1. **Single degree Freedom systems:** Undamped and damped free vibrations: forced vibrations – Viscous damper – Coulomb damper– Response to harmonic excitation, rotating unbalance and support excitation – Vibration isolation and transmissibility - Torsional vibrations. Vibration measuring instruments: Vibrometers, velocity meters & accelerometers.

2. **Two degree freedom systems:** Principal modes – undamped and damped free and forced vibrations – undamped and damped vibration absorbers – Torsional vibrations.

3. **Multi degree freedom systems:** Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by modal analysis; method of matrix inversion; Torsional vibrations of multi – rotor systems and geared systems.

4. **Continuous systems:** Beams and Beams on Elastic foundation

4. **Numerical Methods:** Rayliegh's, stodola's, Matrix iteration and Holzer's methods.
   Continuous systems: Free vibration of strings – longitudinal oscillations of bars- traverse vibrations of beams- Torsional vibrations of shafts.

5. **Critical speeds of shafts:** Critical speeds without and with damping, secondary critical speed.

Text books:

1. Vibrations by W.T. Thomson.
2. Mechanical Vibrations by G.K. Groover.

References:

1. Elements of Vibration Analysis by Meirovitch.
2. Mechanical Vibrations by Den Hortog.
3. Mechanical Vibrations – Schaum series.
4. Vibration problems in Engineering by S.P. Timoshenko.

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THEORY OF PLATES

1. **DERIVATION OF PLATE EQUATIONS FOR –**In plane bending and transverse bending effects.

2. **RECTANGULAR PLATES:** Plates under various loading conditions like concentrated, U.D.L and hydrostatic pressure- Navier and Levy's type of solutions for various boundary conditions.

3. **CIRCULAR PLATES:** Symmetrically loaded, circular plates under various loading conditions, annular plates.

4. **PLATES ON ELASTIC FOUNDATIONS:** Navier and Levy's type solutions for simple cases, plate carrying rows of equivalent columns.

5. **PLATES UNDER SIMULTANEOUS BENDING AND STRECTHING:** Derivation of the governing equation and application to simple cases.

6. **ORTHOTROPIC PLATES:** Derivation of the governing equation, applications to grillage problems as equivalent orthotropic plates.

7. **NUMERICAL AND APPROXIMATE METHODS: E**nergy solutions by variational methods, finite difference and finite element methods of analysis for plate problems.

8. **LARGE DEFLECTION THEORY OF PLATES:** Study of few simple cases, Influence surfaces.

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GROUND IMPROVEMENT TECHNIQUES

1. Introduction – Need for Engineering Ground – Classifications of Ground Modification Techniques – Suitability, Feasibility and Desirability. Densification of cohesionless soils – deep Compaction – Vibroflobation – Vibro Composer method Blasting – Densification at Ground. - Vibrocompaction - Heavy Tamping, Stability of foundation trenches and surrounding structures through soil Nailing.
2. Stabilisation- Mechanical Stabilisation, Lime Stabilisation, Cement Stabilisation, Bitumen Stabilisation, Thermal Stabilisation and Chemical Stabilisation.
3. Dewatering Techniques - Dewatering methods – open sumps and ditches – gravity flow wells – Vacuum dewatering – Electro – kinetic dewatering – electrosmosis - Practical aspects of electromosis applications
4. Improvement of Cohesive soils – Preloading Soil Replacement – Radial Consolidation – Vertical and Radial Consolidation - Vertical Drains – Sand Drains – Effect of Smear – Sandwicks – Band drains – Dynamic Compaction.
5. Stone Columns – Methods of installation of Stone Columns – Load shared by stone columns and the stabilized ground – uses of stone columns Lime columns and granular trenches – Installation – Improvements expected on Soil behavior. In situ ground reinforcement – ground anchors – types – Components and applications – uplift capability.
6. Grouting – Overview - Suspension grouts – Solution grouts – Methods of grouting – Grouting applications – Dams, Tunnels, Shafts and drifts, excavations,

REFERENCE:

1. Construction and Geotechnical Methods in Foundation Engineering By R.M. Koerner, McGraw – Hill Book Co.
2. Current Practices in Geotechnical Engineering Vol.1, Alam Singh and Joshi, International Book Traders, Delhi, & Geo-Environ Academia.
3. Foundation Analysis and Design (1V Ed.) By J.E. Bowles, McGraw – Hill Book Co.,
4. Ground Improvement Techniques by P. Purushotham Raj, Laxmi Publications (P) Ltd., New Delhi.
5. Ground Improvement – Edited by M.P. Moseley, Blackie Academic & Professional.
6. Soil Mechanics for Road Engineers, H.M.S.O, Londan.
7. Ground Improvement Techniques by Bergado et al.

SOIL DYNAMICS AND MACHINE FOUNDATIONS

1. Introduction: Types of motion- SHM- Fundamental definitions- SDOF systems- Free and forced vibration with and without damping- Types of damping-Equivalent stiffness of springs in series and parallel- Principles of vibration measuring devices- Introduction to two and multi degree freedom systems
2. Theories of Vibration Analysis- EHS Theory and lumped parameter model- Different modes of vibration
3. Dynamic properties of soils, Determination of E, G and Poisons ratio from field and laboratory tests, recommendations of Indian codes- Stress waves in bounded elastic medium- Use of wave theory in the determination of elastic properties, Elastic coefficients of soils and their determination- damping from free and forced vibration tests- Construction and working of different types of oscillators, transducers and their characteristics, oscilloscopes and Oscillographs etc.
4. Machine Foundations: Classification based on the type of dynamic force and structural form, design data, design criteria, foundations for reciprocating, impact and high speed machined like turbo generators- IS code provisions for the design of the same
5. Vibration Isolation: Transmissibility, Principles of isolation- Methods of isolation- Vibration isolators- Types and their characterizes.
6. Special topics- Liquefaction of soils, Dynamic bearing capacity, Earth retaining structures under dynamic loads-Pile foundations

REFERENCES:

1. Vibrations of Soils and Foundations – Richart Hall and Woods
2. Vibration Analysis and Foundation Dynamics, NSV Kameswara Rao, Wheeler Publishing, New Delhi.
3. Foundations of Machines- Analysis and Design- Prakash and Puri
4. Analysis and design of Foundations for Vibrations- P J Moore
5. Fundamentals of Soil Dynamics- B M Das
6. Dynamics of bases and Foundations- D D Barkar

FOUNDATION ENGINEERING

1. Soil Exploration – Importance, Terminology, Planning - Geophysical methods. Borings - Location, spacing and depth, Methods of Boring including Drilling, Stabilization of Boreholes, Boring records. Soil sampling – Methods of sampling -Types of Samples and Samplers- Cleaning of Bore holes, Preservation, Labeling and Shipment of Samples - Design Considerations of Open Drive Samplers. Field tests - The Standard Penetration Test – its limitations and Corrections – Cone Penetration Test – Field Vane Shear Test – Bore–Hole Shear Test – Dilatometer Test – Pressure Meter test – Preparation of Soil Report
2. Shallow Foundations – Types and choice of type. Design considerations of including location and depth, Bearing capacity – General bearing capacity equation, Meyerhof's Hnnsen's and Vesic's bearing capacity factors; Bearing capacity of stratified; soils; Bearing capacity based on penetration resistance, safe bearing capacity and allowable bearing pressure.
3. Settlement Analysis – Elastic settlement in granular soils – Meyerhof's De beer and Marten's and schemertmann's equationsl; Elastic settlements of clays; Skempton and Bjerrum's psuedo – Three dimensional approach for consolidation settlement, settlement from in-situ tests. Tolerable settlements.
4. Proportioning of shallow foundations- isolated and combined footings and mats, Design procedure for mats; floating foundation, fundamentals of beam on Elastic foundations.
5. Pile foundations – Classification methods – Factors influencing their choice – Load carrying Capacity of piles by static pile formulae in clays and granular soils - $\alpha\beta$ and λ - methods for piles in clays; Meyerhof's, Vesic's equations and Coyle and Castello correlations for piles in sands; (Elastic settlement of piles)- Pull out resistance of piles – Load carrying capacity using Dynamic pile formula – Pile load tests – cyclic pile load tests.
6. Laterally loaded vertical piles Modulus of sub – grade reaction – Pile in granular sols and cohesive soils subjected t lateral loading, Matlock & Reese analysis, Davisson & Gill analysis, Broms' Analysis.
7. Under – reamed pile foundations – construction techniques – design specifications – pile carrying capacity in compression and uplift of single and multi – under reamed piles in clays and sands. Negative skin friction in piles – typical field situations – Estimation of downdrag in single piles and pile groups – methods of minimizing downdrag.
8. Drilled pier and Caisson Foundations – Types of Drilled piers – load carrying capacity of piers in clays and sands, uplift capacity of piers, caissons – Types – Pneumatic Caisson – Well Foundations – Design of components – Lateral stability of well foundations – Terzaghi's analysis.

REFERENCES

1. Earth manual – Oxbord and IBH publishing company
2. Soil Mechanics in Engineeirng Practice by Terzagi and Peck
3. Foundation Design by Wayne C. Teng, John Wiley & co.,
4. Foundation Analysis and Desing by F.E. Bowles Mc. Graw Hill publishing Co.,
5. Analysis and Design of sub structures b. Swami saran,
6. Principles Foundation Engineering by Braja M. Das.
7. Design Aids in Soil Mechanics and Foundation Engineeirng by Shanbaga, R. Kaniraj
8. Foundation Design and construction by MJ Tmlinson – longman scientific

EARTH RETAINING STRUCTURES

1. Earth pressures – Different types and their coefficients- Classical Theories of Earth pressure – Rankine's and Coulomb's Theories for Active and Passive earth pressure- Computation of Lateral Earth Pressure in Homogeneous and Layered soils- Graphical solutions for Coulomb's Theory in active and passive conditions.
2. Retaining walls – different types - Type of Failures of Retaining Walls – Stability requirements – Drainage behind Retaining walls – Provision of Joints – Relief Shells.
3. Braced cuts – Lateral Pressure in Braced cuts – Design of Various Components of a Braced cut – Stability of Braced cuts – Bottom Heave in cuts.
4. Sheet Pile Structures – Types of Sheet piles – Cantilever sheet piles in sands and clays – Anchored sheet piles – Free earth and Fixed earth support methods – Row's moment reduction method – Location of anchors, Forces in anchors.
5. Soil reinforcement – Reinforced earth - Different components – their functions – Mechanics of reinforced earth – Failure modes-Failure theories – Design of Embakments on problematic soils.
6. Cofferdams – types, suitability, merits and demerits – Design of single – wall cofferdams and their stability aspects – TVA method and Cummins' methods.

REFERENCES

1. Principles of Foundation Engineering by Braja M. Das.
2. Foundation analysis and design – Bowles, JE – McGraw Hill
3. Soil Mechanics in Engineering Practice – Terzaghi, K and Rolph, B. peck 2nd Edn. – John Wiley & Co.,
4. Analysis and Design of Foundations and Retaining Structures, Prakash, S – Saritha Prakashan, Mearut.

DESIGN WITH GEOSYNTHETICS

1. Geosynthetics:

Introduction to Geosynthetics – Basic description – History – Manufacturing methods – Uses and Applications.

2. Properties and Testing Methods:

Properties and Testing methods of Geotextiles – Geogrids – Geomembranes – Geocomposites.

3. Geotextiles:

Designing for Separation – Reinforcement – Stabilization – Filtration – Drainage and Moisture barriers.

4. Geogrids:

Designing for Reinforcement – Stabilization – Designing Gabions – Construction methods – Design of retaining walls.

5. Geomembranes:

Survivability Requirements – Pond Liners – Covers for Reservoirs – Canal Liners – Landfill Liners – Caps and closures – Dams and Embankments.

6. Geocomposites:

Geocomposites – An added advantage – Geocomposites in Separation – Reinforcement – Filtration – Geocomposites as Geowebs and Geocells – Sheet drains – Strip drains and Moisture barriers.

REFERENCE:

1. "Designing with Geosynthetics by Robert M. Koerner Prantice Hall, Eaglewood cliffs, NJ 07632.
2. "Construction and Geotechnical Engineering using Synthetic Fabries" by Robert M. Koerner and Josoph P. Welsh. John Willey and Sons, New York.
3. "Engineering with Geosynthetics", by G. Venkatappa Rao and GVS Suryanarayana Raju – Tata McGraw Hill Publishing Company Limited – New Delhi.
4. "Foundation Analysis and Design" by J.E. Bowles McGraw Hill Publications.

SOIL – STRUCTURE INTERACTION

1. Introduction to Soil – Foundation Interaction Problems – Contact Pressure Distribution – Idealized Soil Behaviour, Foundation Behaviour, Interface Behaviour, Analytical techniques.
2. Idealized Soil Response Models for the Analysis of Soil – Foundation Interaction – Elastic Models for Soil Behaviour, Cointler model, Elastic Continuous Model, Two – Parametric Elastic Models – Elastic – Plastic and Time Dependent Behaviour of Soil Masses.
3. Plane Strain Analysis of an Infinite plate and an Infinitely Long. Beam; Bernoulli – Euler Beam Theory and its Modifications – Effect of Shear Deformations.
4. Finite Beams on a Winkler Medium – Method of Initial Parameters – Method of Super Position – Strain Energy Method.
5. Axi-Symmetric Three – Dimensional Problem of an Infinite Plane – Possion – Virth off-Plate Theory – Boundary Conditions for their Elastic Plates.
6. Analysis of finite plats – Axi Symmetric Leading of a Circular Plate – Circular Plate Resting on a Winkler Medium – Circular Plate Resting on a Two – parameter elastic.

REFERENCE:

1. Soil mechanics by TW Lambe & Whitmen.
2. Analytical and computer methods in foundation engineering, JE Bowles, McGraw Hill publications.
3. Foundation analysis and design, JE Bowles, McGraw Hill Publications.
4. Foundation analysis by RF Scott, Printice Hall
5. Hytenyi, Beams on Elastic Foundations – university of Michigan Press.
6. Elastic Analysis of soil – Foundation Interaction. APS Selvadurai – Elsevier
7. Vibration Analysis and Foundation Dynamics, NSV Kameswara Rao, Wheeler Publishing, New Delhi.

GEOTECHNICAL EARTH QUAKE ENGINEERING

Earthquake Seismology: Seismic waves - Causes of earth quake - Continual drift and Plate tectonics – Earthquake fault sources – Faults, fault geometry, fault movement - Elastic Rebound Theory – Location of Earth Quakes - Quantification of Earthquakes – Intensity and magnitude – Earthquake Energy.

Earthquake ground motion: Seismograph - Characteristics of Ground motion: - Ground motion parameters – Amplitude Parameters – peak acceleration, peak velocity, peak displacement other amplitude parameters – Frequency content parameters – ground response spectra, Fourier spectra, Power spectra, response spectra – spectral parameters – duration. Local site Specification and Code based design.

Dynamic Soil Properties: Representation of Stress conditions by the Mohr Circle – Measurement of Dynamic properties – field, laboratory, interpretation of observed ground response.

Ground Response Analysis: One dimensional response analysis - linear approach, Equivalent linear approach.

Liquefaction and Lateral Spreading – Liquefaction Related phenomena - Liquefaction susceptibility – Initiation of Liquefaction – Effect Liquefaction.

Seismic Design of Foundation: Seismic Design requirements for Foundation – Seismic Bearing capacity - Seismic Settlement.

Seismic Slope Stability Analysis: Internal stability and weakened instability - Seismic design of retaining walls: Dynamic Response of Retaining walls - Seismic Displacement of Retaining walls -Seismic Design Considerations.

1. *"Geotechnical Earth Quake Engineering"* by SL Kramer, Pearson Education.
2. *"Earth Quake"* W.H. Freeman, New York.

PAVEMENT ANALYSIS AND DESIGN

1. Pavement Types, Wheel Loads and Design Factors

   Definition of Pavement Types, Comparison of Highway pavements, Wheel Loads, Tyre pressure, Contact pressure, Design Factors: Traffic and Loading, Environment, Materials, Failure criteria, Reliability.

2. Stresses in Pavements

   Layered System Concepts: One Layer System: Boussinesq Theory. Two Layer Theory: Burmister's Theory. Three Layer System. Stresses in Rigid Pavements. Relative Stiffness of Slabs, Modulus of Subgrade Reaction, Stresses due to Warping, Stresses due to Friction, Stresses due to Load, IRC Recommendations.

3. Pavement Design

   IRC Method of Flexible Pavement Design, AASHTO Method of Flexible Pavement Design, IRC Method for Rigid Pavements, use of Geosynthatics in pavements.

4. Pavement Inventories

   Serviceability Concepts, Visual Rating, Pavement Serviceability Index, Roughness Measurements, Measurement of Distress Modes Cracking, Rutting, Rebound Deflection using Benkleman Beam Deflection Method, Load Man Concept, Skid Resistance Measurement.

5. Pavement Evaluation

   Functional Pavement Performance Evaluation: AASHTO Method, Psycho Physical and Psycho Metric Scaling Techniques, Deduct Value Method.

   Structural Conditional Evaluation Technique: Benkelman Beam Deflection Method, Pavement Distress Rating Technique. Design of Overlays by Benkelmen Beam Deflection Methods as per IRC – 81 - 1997 – pavements on problematic soils.

REFERENCES:

1. Yoder and Witzorack, "Principles of Pavement Design", John Willey and Sons.
2. Yang, H. Huang, "Pavement Analysis and Design", Prentice Hall Publication, Englewood Cliffs, New Jersy.
3. Sargious, M.A. Pavements and Surfacings for Highways and Airports – Applied science Publishers limited
4. Ralps Hass and Hudson, W.R. " Pavement Management System" Mc-Graw Hill Book Company.
5. IRC codes of practice.

NUMERICAL METHODS IN GEOTECHNICAL ENGINEERING

1. Introduction: Categories of Problems in Geo-technical Engineering, Finite Difference Method, Boundary Corrections for Grids. Accuracy, Convergence and Stability.
2. Idealization of soil behaviour; Linear, Bilinear and multi-linear, Hyperbolic, Spline function, Ramberg – Osgood's Model, Polynomials, Higher order elastic models, perfect plasticity, frictional. Elastic models of soil behaviour – The winkler – Filenenko-boroditch – Pasternak – Ressiener models.
3. Seepage: Finite Difference Solution to Laplace equation for Homogeneous and Layered Soils.
4. Consolidation: Finite Difference Solution for One Dimensional, Two and three dimensional consolidations. Multi layered systems. Consolidation of Ground for Construction Load and Static Load.
5. Shallow Foundations: Beams on Elastic foundations, solution by Finite Difference and – Finite Element Method (Direct Approach) Limit analysis, Lower Bound and Upperbound theories Method of Finite difference solution of Raft foundations.
6. Pile Foundation: Pile Stresses – Static loading – Finite Element Method Solution (Direct approach) of the pile static pile capacity- wave equation.

   Pile Group: Finite Element Method (Direct Approach) method of Analysis for pile groups.

   Lateral Piles:Lateral piles by Finite Element Method – Finite Difference method – Soil modulus and Non-linearity – Pile length or partial embedment case – pile head fixity.
7. Sheet pile wall: Solution to sheet pile wall by Finite Element Method and FDM – Cohesion & Cohesion loss soils – Free – Fixed Anchored sheet pile walls.
8. Mechanical Vibrations – Finite Difference Solution for Free and Forced, Undamped and damped single and two degree of freedom systems.

REFERENCE:

1. Numerical methods in Geotechnical Engineering by C.S. Desai and J.T. Christian McGraw Hill publications.
2. Analytical and computer methods in foundation engineering, JE Bowles, McGraw Hill publications.
3. Foundation analysis and design, JE Bowles, McGraw Hill publications
4. Foundation analysis by RF Scott, Printice Hall
5. Hytenyi, Beams on Elastic Foundations – university of Michigan Press.
6. Elastic Analysis of Soil – Foundation Interaction, APS Selvadurai – Elsevier
7. Pile Foundation Analalysis & Design by Poulos and Davis.

ADVANCED SOIL MECHANICS

1. Clay Mineralogy: Nature of soils – Clay mineral structure –Cation exchange – Soil water – Soil structure-Soil-Water interaction-Swelling-factors affecting swelling – swelling potential- swell pressure - Methods of determination – factors affecting swelling potential and swell pressure.
2. Permeability: Darcy's law – Validity of Darcy's Law – Factor's affecting – Coefficient of Permeability of Stratified Deposits – Theoretical Solution for Coefficient of Permeability – Coefficient of Permeability in the Field.
3. Seepage: Equation of Continuity – Use of Continuity Equation for Solution of Simple flow problems – Flow nets – hydraulic uplift force under structure – Flow nets in anisotropic material – Construction of flow nets for hydraulic structures on non-homogeneous subsoils – Directional variation of permeability in anisotropic medium – Seepage through earth dams – Entrance, discharge and transfer condition of line of seepage through earth dams. Flow net construction for earth dams – filter design.
4. Consolidation: Mechanism of consolidation – Primary consolidation – Stress history – Pre-consolidation pressure – Terzaghi's one-dimensional consolidation theory and equation – Solution by Fourier series and finite difference methods – Determination of coefficient of consolidation – U versus T relationship for different forms of initial excess pore water pressure distribution – Degree of consolidation under time – dependent loading – secondary compression.
5. Heave: Stresses in soil mass-factors affecting heave- methods of determination of heave.
6. Shear strength: Principle of effective stress – Measurement of strength parameters - Strength tests based on drainage conditions – Skempton's pore pressure coefficients – Stress paths – Shear strength of cohesionless soils – Strength and deformation behaviour – Dilatancy – Critical void ratio – Liquefaction of soils – Shear strength of saturated cohesive soils – Triaxial testing. Normally and over consolidated clays.
7. Shear strength of expansive soils – Katti's concept of bilinear strength envelope – Stress – state variables in partly saturated soils - Fredlend's strength parameters Determination of matrix suction by axis translation technique Field suction measurement.

REFERENCES

1. " Advanced soil mechanics" by Braja M. Das., McGraw Hill Co.,
2. " Foundations of theoretical soil mechanics" by M.E. Harr., McGraw Hill Co.
3. " Fundamentals of soil behaviour " by J.K. Mitchell., John Wiley & Sons.
4. "Introduction to Geotechnical engineering" by Holtz and Kovacs., Prentice Hall.
5. "Soil Mechanics" by R.F.Craig, Chapman and Hall.
6. "Elements of soil mechanics" by G.N. Smith., B.S.P. Professional Books, Oxford, London.
7. " Foundation on expansive soils" by F.H.Chen,Elsevier

ADVANCED SOILMECHANICS.

CHAPTERS 1: Principles of Elasticity and Plasticity

Concept of stress and strain – Principal stresses – Stress – strain relationships – Plane stress and plane strain – Mohr's diagram – Yield criteria – Theories of failure – Mohr – Coulomb failure condition.

CHAPTER 2: Clay Mineralogy -Nature of soils – atomic bonds - Clay mineral structure – clay water relation – electrical effects – clay mineral identification – Soil fabric and structure

CHAPTER 3: Water flow in Soils

Flow equation – Darcy's Law – General equation – mathematical analysis – solution by sketching – electrical analogy – numerical solution

CHAPTER 4: Transient Flow

Effective stress - change in degree of saturation – change in void ratio – compressibility of pore water – compressibility of soil solids – rate of storage equation – transient flow condition – one dimensional consolidation – mathematical analysis – approximate numerical analysis.

CHAPTER 5 Consolidation

Mechanism of consolidation – Primary consolidation – Stress history – Pre-consolidation pressure – Terzaghi's one-dimensional consolidation theory and equation – Solution by Fourier series and finite difference methods – Determination of coefficient of consolidation including Scott's method – U versus T relationship for deferent forms of initial excess pore water pressure distribution – Degree of consolidation under time – dependent loading – secondary consolidation.

CHAPTER 6 Shear strength

Principle of effective stress – Measurement of strength parameter – Strength tests based on drainage conditions – Skempton's pore pressure coefficients – Stress paths – Hvorslev' spacing parameters – Shear strength of cohesion-less sands – Strength and deformation behaviour – Dilatancy – Critical. Void ratio Liquefaction – Shear strength of saturated cohesive soils – Tri-axial testing – Normally and over consolidated clays – Partially saturated clays – Stress – state variables – Measurement of pore- water and pore – air pressure – Axis translation technique.

REFERENCES:

8. " Foundations of theoretical soil mechanics" by M.E. Harr., McGraw Hill Co.
9. " Fundamentals of soil behaviour " by J.K. Mitchell., John Wiley & Sons.
10. " Advanced soil mechanics" by Braja M. Das., Mc Graw Hill Co.,
11. "Introduction to Geotechnical engineering" by Holtz and Kovacs., Prentice Hall.
12. "Elements of soil mechanics" by G.N. Smith., B.S.P. Professional Books, Oxford, London.

EARTH DAMS

1. BASIC CONCEPTS AND MISCELLANEOUS TOPICS.

Evolution – Types of Dams – Earthfill Dams – Rockfill Dams – Selection of Type of Dam – Site Topography – Foundation Conditions – Availability of Materials – Spill way Location – River Diversion – Time Available for Construction – Future Raising – Basic Design Requirements – Causes of Failure and Deterioration of Dams – Design Investigations – Fill Material – Foundations – Design Studies – Laboratory Investigations – Embankment Construction – Placement and Compaction – Compaction Requirements – Selection of Moisture Content - Quality Control – Instrumentation – Purpose - Types of Instruments and Brief Description – Installation – Crest Width – Freeboard – Definition – Wind Set-up – Wave Height – Design of Slope Protection – Dumped Riprap – Hand-placed Riprap – Soil-Cement Slope Protection – Downstream Slope Protection – Hydraulic Fill Dams – Tailings Dams.

2. SEEPAGE THROUGH DAM SECTION AND ITS CONTROL

General – Flow Nets – Definitions - Casagrande's Method – Flow Net for Anisotropic Section – Quantity of Seepage through Dam Section – Basic Equations – Stello's Seepage Charts - Quantity of Seepage through Foundation – Seepage Control – Filters – Filter Criteria – Filters for Silts and Clays – Critical and Non-Critical Filters – Broadly Graded Soils – Core Material – Core Inclination – Core Thickness – Drainage – Pervious Downstream Shell – Chimney Drains – Rock Toe and Drains – Use of Geotextiles as Filter Material.

3. CONTROL OF SEEPAGE THROUGH FOUNDATIONS

General Considerations – Trench Cut-off – Partial Cut-off – General Considerations – Design of Upstream Blanket – Performance of Upstream Impervious Blanket of Tarbela Dam – Horizontal Drainage Blanket – Relief Wells – General Details – Design of Relief Wells – Drainage Trenches - Downstream Loading Berm – Cut-off Walls –Slurry Trench Cut-off Walls – Concrete Cut-off Walls or Diaphragms – Grouted Cut-offs – General Details – Suspension Grouts – Chemical Grouts – Performance of Seepage-Reducing Measures – Location of Cut-off – Improvements of Foundation Materials – Methods of Improvement – Liquefaction of Soils – Mechanism of Densification – Blastingn - Vibroflotation – Heavy Tamping – Foundation Improvement at Jebba Dam site.

4. STABILITY ANALYSIS

Introduction – Critical Slip Surface – Shear Strength Under Different Test Conditions – Shear-Strength Tests – Test Conditions for Stability Analysis – Pore Pressures under Different Test Conditions – End-of-Construction – Drawdown Pore pressures – Steady Seepage – Factor of Safety – Stability Analysis – Method of Slices – Equilibrium Requirements – Fellenius Method – Simplified Bishop Method – Taylor – Lowe Force-Equilibrium Method – Spencer's Method – Janbu's Method – Equilibrium Equations – Working Formulae – Interslice Forces – Factor of Safety Along Interfaces – Iteration Procedure – Simplified Janbu's Method – Morgenstern – Price Method – Wedge Method – Appraisal of Different Methods of Stability Analysis.

5. EARTHQUAKE RESISTANT DESIGN

Generation of Earthquake and Site Seismicity - Induced Earthquake – Factors Affecting Earth Quake Ground Motion – Characteristics of Earthquake Ground Motions – Response Spectrum – Earthquake Events for Design of Dam – Maximum Credible Earthquake (MCE) – Design Basis Earthquake (DBE) – Past Practice in the Evaluation of Slope Stability During Earthquake – Determination of Seismic Coefficient – Rigid Body Response – Viscoelastic Approach – Average Seismic Coefficient – Estimation of Permanent Displacements – Newmark's Approach – Makdisi and Seed Method – Use of Pseudostatic Method and Performance Experience - Response Analysis by FEM – Soils Affected by Cyclic Loading Conditions – Failure of Lower San Fernando Dam: Post-Earthquake Behaviour – Dams with Upstream Pervious Shell – Pervious Shell of Oroville Dam – Highly Pervious Shell of Dartmouth Dam – Drainage – Provision of Anti – Seismic Collars at Nurek Dam – Comparaion of 2-D and 3-D studies of Dynamic Response – Earthquake Damage – Use of ESI for Estimating Crest Settlement – Defensive Design Measures – Summary of Design Recommendations - Performance Experience – Oroville Dam – E1 Infiernillo and La Villita Dams.

REFERENCE:

1. Earth Dams by HD Sharma
2. Earth and Rockfill Dams HD Sharma & Bharat Singh

GEO-ENVIRONMENTAL ENGINEERING

UNIT I

Introduction to Ground water contamination, pollutant transport and ground water remediation. Sources and Types of ground water contamination – introduction – under ground storage tanks, Land fills, surface impoundments, waste disposal injection wells, Septic system, Agricultural wastes, Land application, radioactive contamination, other sources of contamination.

UNIT II

Data Collection methods: Introduction, Geological data acquisition – Drilling methods – Solid flight auger drilling – Hollow stem auger drilling – Wet rotating drilling – Hand auger soil boring – sample collection – Soil core logging – Cone penetration testing – Geophysical methods; Hydrologic data acquisition – monitoring well construction – well material – Screen interval selection – Installation procedure – Survey specification – Protective casing requirements – Well development procedures; Acquisition of soil and Ground water quality data.

UNIT III

Contaminant Transport Mechanisms: Introduction – Advection process – Diffusion – Dispersion process – Diffusion – Mass transport Equations : Derivation of advection dispersion equation for solute transport; One Dimensional Models – Continuous source in one dimension – Instantaneous source in one dimension – Adsorption effects – Transport in one dimensional with first order decay – Sorption: The concept of sorption, Factors influencing sorption – Contaminant characteristics, Soil characteristics, Fluid media characteristics. Sorption Isotherm: Linear sorption Isotherm – Freundlich Sorption isotherm – Langmuir Sorption Isotherm, Sorption effects on fate and transport of pollutants.

UNIT IV

Flow and Transport of Pollutants in Unsaturated zone: Capillarity, soil-water characteristic curves, Unsaturated Hydraulic conductivity, Governing equation for unsaturated flow, measurement of soil properties.

UNIT V

Non – Aqueous Phase Liquids (NAPLs): Introduction – Comparison of fate of dissolved mass versus NAPL mass- Types of NAPLs – LNAPL – DNAPL; NAPL Transport – general process – NAPL transport at the pore level - Downward Migration of DNAPLs in saturated zone – NAPL movement through Vadose zone – LNAPL behaviour at the water table – NAPL Transport at the site level – LNAPL conceptual models – DNAPL conceptual models, NAPL transport.

TEXT BOOKS:

1. Ground water Contamination (Transport and Remediation) By Philip. B. Bedient, Hanadi, S. Rifai & Charles. J. Newell, Prentice Hall PTR, Upper Saddle River, NJ07458.

REFERENCES

1. Geoenvironmental Engineering by R. Krishna Reddy - John Wiley & Sons, Inc.
2. Geotechnical Engineering by Gulahati, S.K. and Datta, M. – Tata Mc Graw Hill Publishing Company
3. Geotechnical Engineering Principles and Practices by Coduto – Pearson Education (PHI)
4. Geoenvironmental engineering by Reddy, L.N and Inyang, I.H. – Marcel Drekker, 2000.
5. Environmental geotechniques by Sarsby, R. – Thompson Telford, 2000.
6. Geotechnical Practices for Waste Disposal by Daniel, D.E., 1993.

THEORY OF ELASTICITY AND PLASTICITY

1. INTRODUCTION:
Elasticity –Notation for forces and stresses-Components of stresses –components of strain –Hooke's law.

2. PLANE STRESS AND PLANE STRAIN ANALYSIS:
Plane stress-plane strain-Differential equations of equilibrium- Boundary conditions-Compatability equations-stress function-Boundary conditions.

3. TWO DIMENSIONAL PROBLEMS IN RECTANGULAR COORDINATES:
Solution by polynomials-Saint Venant's principle-Determination of displacements-bending of simple beams-application of Fourier series for two dimensional problems - gravity loading.

4. TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES :
General Equation in polar co-ordinates - stress distribution symmetrical about an axis – Pure bending of curved bars- strain components in polar coordinates-Displacements for symmetrical stress distributions-simple symmetric and asymmetric problems-General solution of two dimensional problem in polar coordinates-Application of the general solution of two dimensional problem in polar coordinates-Application of the general solution in polar coordinates.

5. ANALYSIS OF STRESS AND STRAIN IN THREE DIMENSIONS: Principle stress - ellipsoid and stress-director surface-Determination of principle stresses-Maximum shear stresses-Homogeneous deformation-principle axis of strain rotation.

6. GENERAL THEROMS:
Differential equations of equilibrium- conditions of compatibility - Determination of displacement-Equations of equilibrium in terms of displacements-principle of superposition-Uniqueness of solution –the Reciprocal theorem.

7. TORSION OF PRISMATICAL BARS:
Torsion of prismatic bars- Elliptical cross section-other elementary solutions-membrane anology-Torsion of rectangular bars-solution of torsional problems by energy method-use of soap films in solving torsionol problems-hydra dyanmical analogies-Torsion of shafts, tubes, bars etc.

8. THEORY OF PLASTICITY:
Introduction- concepts and assumptions -yield criterions.

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REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEMS

UNIT I:Remote Sensing : Definition, Elements involved in Remote Sensing, Ideal Vs Real Remote Sensing, Characteristics of Real Remote Sensing System, Nature of Electromagnetic Radiation. The Electromagnetic Spectrum, Remote Sensing Terminology and Units, Energy Interaction with Earth Features, Vegetation, Soils and Water bodies, Energy interaction in the atmosphere. Spatial Resolution, Spectral Resolution and Radiometric Resolution, Characteristics of Various sensors and satellites: LANDSAT, SPORT, IRS, ERS.

UNIT II: Introduction to GIS: What is GIS – Components of GIS, Overview of GIS, Examples of GIS application for Agriculture and use planning, Geology and Municipal applications. Using a GIS for Decision making under uncertainty, Geo-referenced data. Use of GIS.
Data Input/Output: Keyboard entry, Manual Digitizing, Scanning, remotely sensed data, Existing Digital data – Cartographic database, Natural resources data sets, Digital elevation data and census related data sets, Data output devices.

UNI III:Data Quality: Components of data Quality, Sources of error. Data management: Data Base approach, Three classic data models (Hierarchical network Relational data models), Query languages, Nature of Geographic data.
Spatial data models: Raster and Vector data models. Data vases for GIS managing Spatial and attribute data together – Organizing Geographic Information within a DBMS, Limitations and Practical Approaches.

UNIT IV:GIS Analysis functions : Organizing data for analysis, Classification of GIS Analysis function, Maintenance and Analysis of Spatial data – Transformations, Conflation, Edge matching and editing, Maintenance and analysis of non-spatial attribute data – Editing and query functions.

UNIT V: GIS analysis functions for Integrated analysis of spatial and attribute data: Retrieval and Classification functions, Overlay operations, Neighborhood operations, Connectivity function, Output, Formatting – Map annotation, Text pattern and line styles, Graphic symbols, Cartographic modeling by GIS, analysis procedure with an example .

TEXT BOOKS:

1. Remote Sensing and Geographical Information Systems – 2nd Edition by M. Anji Reddy.
2. Principles of Remote Sensing by Paul J Curran Geographic Information Systems, - A Management Perspective by STAN ARONOFF, Published by WDL Publications, Ottawa, Canada.
3. Michael Hord. Remote Sensing Methods and Applications, John Wiley.

Environmental Chemistry

UNIT – I:
Introduction of Environmental Chemistry in global perspective – Environmental composition – Anthropogenic effects – The Earth's Atmosphere – Solar influence on the chemical Composition of the atmosphere

UNIT – II:
Stratospheric Chemistry – Ozone – Oxygen only Chemistry – formation and turnover of ozone – Measuring Ozone in the Atmosphere - Processes for catalytic decomposition of Ozone – Chlorofluorocarbons (CFCs) -.Replacements for (CFCs)

UNIT – III:
Tropospheric Chemistry - Smog – The Chemistry of Photochemical Smog – Exhaust gases from the internal combustion engines – Precipitation – The composition of Rain – Atmospheric production of nitric acid – Atmospheric production of Sulphuric Acid – Rain, Snow and fog Chemistry.

UNIT – IV:
Tropospheric Chemistry – Atmospheric aerosols – Sources of aerosols, its concentrations and lifetimes – Air pollution control for particulate emissions -
The Greenhouse gases and aerosols – Greenhouse gases associated with the use of carbon-based fuels

UNIT – V:
The Hydrosphere – Physical and Chemical properties of Water – Gases in Water – Simple gases – Gases that react with water – Alkalinity – Organic Matter in water – Origins of organic matter in water – Environmental issues related to aqueous organic matter.

UNIT – VI:
The Hydrosphere – Aquo Complexes of metals – Classification of metals and their behaviour in the hydrosphere – Microbiological Processes – the Carbon cycle – the nitrogen cycle – the sulfur cycle.- Waste water and its treatment – Advanced microbiological processes.

UNIT – VII:
The terrestrial Environment – Soil formation – Physical and Chemical properties of Soil – Solid wastes from mining and metal production – Organic wastes – Mixed urban waste – Organic Biocides – Chemical Stability – Mobility of biocides – Leachability.

UNIT – VIII:
Analytical Chemistry – Analytical techniques and methods – Titrimetry - pH metry – Conductometry - Separation techniques – Principles of Chromatography – Thin-layer chromatography – Gas chromatography – principles and instrumentation – Spectrometric techniques – Ultraviolet and visible spectrometry – principle and instrumentation – Atomic Absorption Spectrometry

Reference Books :

1. Environmental Chemistry by Gary W. vanLoon and Stephen J. Duffy (Oxford University Press)
2. Chemistry for Environmental Engineering by Sawyer and McCarty

Industrial Waste Treatment

UNIT I
Quality requirement of boiler and cooling waters – Quality requirements of process water for Textiles – Food processing and Brewery Industries – Special Treatment processes.
UNIT II
Basic Theories of Industrial Waste water Management - Volume reduction – Strength reduction – Neutralization – Equalization and proportioning. Joint treatment of industrial wastes and domestic sewage - consequent problems.

UNIT III
Industrial waste of water discharges into streams. Lakes and oceans and problems.

UNIT IV

Recirculation of Industrial Wastes – Use of Municipal Waste Water in Industries.

UNIT V
Industrial Wastes – Special characteristics & treatment of Liquid Wastes from the following industries: textile, tannery, Paper and Pulp. Distilleries, Dairy, Fertilizer Plant, Sugar ill, Steel plants, oil Refineries, - Pharmaceutical plants – thermal power plants.

TEXT BOOKS:
1. Liquid waste of Industry by Nemerow.
2. Waste Water Treatment by Rao and Dutta.
3. Water and Waste Water technology by Mark J. Hammer and Mark J. Hammer (jr)

Principles and Applications of Remote Sensing, GIS

Unit I

Fundamentals: Definition – Scope – types- chronological development – Energy sources – Electro Magnetic Radiation

Unit II

Energy interactions: energy interaction in the atmosphere – atmospheric windows –energy interaction with earth surface features- spectral reflectance patterns for different regions of EMR. Factors affecting remote sensing signatures –

Unit III

Platforms: Types of Platforms – Ideal and real remote sensing system. Advantages and limitations of satellite remote sensing.

Unit IV

Geostationary Satellites and Data Products - Satellite programs of the world - geostationary satellites and Data Products – orbit system – sensor characteristics - meteorological, ocean monitoring and telecommunication satellites. Applications – Ground truth data collection – Satellite data types.

Unit V

Remote Sensors: Electro-optical sensor systems – LANDSAT, SPOT, IRS, Quick bird and IKONOS, other recent satellites – scanning and orbiting mechanisms – resolutions - Image interpretation elements, LiDAR. Applications

Unit VI

Thermal Remote Sensing: materials – thermal inertia of Earth surface features. Thermal IR detection and imaging – characteristics of TIR images. Factors controlling IR Survey – applications.

Unit VII

Microwave Remote Sensing: – aircraft radar system – SLAR – components, imaging system, wavelengths – range and azimuth resolution – real aperture and synthetic aperture systems, image interpretation, Risat, ASTER, SRTM. Application of Hyperspectral data, MODIS

Principles of Geomorphology

Fundamental concepts.

An analysis of Geomorphic process Weathering, Soil Process, Mass-wasting; Geomorphic agents and process ,Geomorphic significance of Weathering, Soils, Mass – wasting

Fluvial Geomorphological cycle, Stream deposition: Streams and valleys ,Classification, Drainage patterns and their Significance, Texture, Meandering and erosion Stream deposition , Classification

The Pen-plain concept, Topography on Domal structures: Types of Domal Structures, Examples of Domal Topography, Geomorphic cycle on folded strata Topography upon faulted structures etc., Horsts , Grabens and related forms

The Arid Cycle Eolian Land forms: Contrasts between Arid and humid regions, The Pediment problem, Arid erosion cycle. Topographic effects of wind erosion, Eolian deposits, The Karst geomorphic cycle, depositional landforms

Geomorphology of coasts: Movements of water in oceans and lakes, Marine erosion, marine deposition, coasts.

Paleogeomorphology: Relict land forms. Buried land forms Ex-humid land forms

Applied Geomorphology: Application of geomorphology to hydrology, to Economic geology, Engineering projects, to Oil Exploration and others.

Air Pollution & Control

UNIT I

Air Pollution – Definitions, Scope, Significance and Episodes, Air Pollutants – Classifications – Natural and Artificial – Primary and Secondary, point and Non – Point, Line and Area Sources of air pollution .

UNIT II

Effects of Air pollutants on man, material and vegetation; Global effects of air pollution – Green House effect, heat Isands, Acid Rains, Ozone Holes etc.

Thermodynamics and Kinetics in Air-pollution – Applications in the removal of gases like SO; NO; CO; HC etc., air –fuel relation. Computation and Control of products of Combustion

UNIT III

Meteorology and plume Dispersion; properties of atmosphere; Heat, Pressure, Wind forces, Moisture and relative Humidity; influence of Meteorology phenomena on Air Quality.

Lapse Rates, Pressure Systems, Winds and moisture plume behaviour and plume Rise Models; Gaussian Model for Plume Dispersion.

UNIT IV

General Methods of Control of NO and SO emissions – In –plant Control Measures, process changes, dry and wet methods of removal and recycling.

UNIT V

Control of particulate – Control at Sources, Process Changes, Equipment modifications, Design and operation of control.
Equipment's – Settling Chambers, Centrifugal separators, filters Dry and Wet scrubbers, Electrostatic precipitators.
Air Quality Management – monitoring of SPM, SO; NO and CO Emission Standards.

TEXT BOOKS:

1. Air Pollution By H.G. Perkins,
2. Environmental Pollution Control Engineering By C.S. Rao
3. Air Pollution and Control By K.V.S.G. Murali Krishna.
4. Air Pollution and Control By Wark and Warner

Syllabi for Pre.PhD/Pre M.Phil/Pre MS. *W.e.f. 2009-2010 Batch*

Subject Code: R90562

PHYSICO-CHEMICAL PROCESSES FOR WATER QUALITY CONTROL

1) Principles of Sedimentation – Classes of Sedimentation Factors affecting, efficiency, inlets, outlets, baffles, flow dispersion patterns, sludge removal devices.Coagulation – stability of colloids – Theory and use of coagulants, aids, dosing and mixing devices floculators (Mechanical and hydraulic) velocity gradients – design of clarifioculator units – Flotation diffused air flotation and dissolved air flotation.

2) Theory of filtration – Hydraulics of flow through porous media, backwashing, different types of filters, components and appurtenances. Filtrability index, mathematical modeling, Design of filters slow / rapid / multi media filters

3) Theory of disinfection – factors affecting disinfection – concentration, time, temperature, pH – Kinetics of disinfection free and combined available chlorine, residuals application of chlorine, methods other than chlorine – chemical / other methods.

4) Aeration and Gas transfer processes – Rates of transfer – factors, affecting – Theories of adsorption – Principles of mass transfer, adsorption Isotherms, rate of Sorption design of sorption columns, activated carbon use, removal of fluorides.

5) Ion exchange process – materials, reactions, operatic methods and applications, removal of Hardness, Iron, requirement of Chemicals.Membrane processes – separation – Reverse osmosis practical uses, Dialysis.Corrosion control and water conditioning.

Suggested books for Reference :

1. Water supply and waste water engineering by Fair, Geyer and Okum.
2. Physico-chemical Treatment methods for water quality control by W.J. Weber.
3. Unit operations of Sanitary Engineering by Rich.

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STRUCTURAL GEOLOGY& PETROLOGY

Mechanical Principles: Materials of Structural Geology, Force, Stress, Strain, Factors controlling behavior of materials

Description of folds, Field study of folds, Techniques used in studying of folds: pi diagrams, contour diagrams, Beta diagrams, Use of computers in geology, Structures contour maps etc.,

JOINTS; Genetics classification Joints

Description and Classification of Faults: General characteristics, Classifications, Criteria for Faulting, Types of Faults etc.,

Petrology:

Classification of Igneous Rocks, Common Igneous Rocks in India

Origin of Sedimentary Rocks, Classification & Structures

Mineralogical character of classic Sedimentary rocks
Metamorphic rocks; Metamorphism, metamorphic structure Petrographic characteristic of Metamorphic Rocks

Syllabi for Pre.PhD/Pre M.Phil/Pre MS. *W.e.f. 2009-2010 Batch*

Subject Code: R90509

ENVIRONMENTAL IMPACT ASSESSMENT OF WATER RESOURCES PROJECTS

1. **Basic concept of EIA and Methodologies :** Initial environmental Examination, Elements of EIA, - factors affecting E I A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters. E I A Methodologies: Introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/Benefit Analysis.
2. **Impact of Developmental Activities** and Land use. Introduction, Methodology for the assessment of soil and ground water, Delineation of study area, Identification of activities.
3. **Procurement of relevant soil :** Quality, Impact prediction, Assessment of Impact significance, Identification and Incorporation of mitigation measures. E I A in surface water, Air and Biological environment: Methodology for the assessment of Impacts on surface water environment, Air pollution sources, Generalized approach for assessment of Air pollution Impact.
4. **Assessment of Impact of development Activities** : on Vegetation and wildlife, environmental Impact of Deforestation – Causes and effects of deforestation.
5. **Environmental Audit & Environmental legislation** : objectives of Environmental Audit, Types of environmental Audit, Audit protocel, stages of Environmental Audit, on-site activities, evaluation of Audit data and preparation of Audit report. Post Audit activities **:** The Environmental pollution Act, The water ;Act, The Air (Prevention & Control of pollution Act.), Mota Act. Wild life Act. Case studies and preparation : of Environmental Impact assessment statement for various Industries.

Text books:

1. Environmental Impact Assessment Methodologies, by Y. Anjaneyulu, B.S. Publication, Sultan Bazar, Hyderabad.
2. Environmental Science and Engineering, by J. Glynn and Gary W. Hein Ke – Prentice Hall Publishers

REFERENCE BOOKS :

1. .Environmental Science and Engineering, by Suresh K. Dhaneja – S.K.,Katania &. Sons Publication., New Delhi
3. Environmental Pollution and Control, by Dr H.S. Bhatia – Galgotia Publication (P) Ltd, Delhi

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