Group I

09 CCS - 11 MECHANICS OF DEFORMABLE BODIES

Theory of Elasticity:

Introduction: Definition of stress and strain at a point, components of stress and strain at a point in Cartesian and polar co-ordinates, constitutive relations, equilibrium equations, compatibility equations and boundary conditions in 2-D and 3-D cases.

Transformation of stress and strain at a point, Principal stresses and principal strains, invariants of stress and strain, hydrostatic and deviatoric stress, spherical and deviatoric strains, max. shear stress, max. shear strain.
Plain stress and plain strain: Airy's stress function approach to 2-D problems of elasticity, simple problems of bending of beams. Solution of axi-symmetric problems, stress concentration due to the presence of a circular hole in planes.
Elementary problems of elasticity in three dimensions, stretching of a prismatical bar by its own weight, twist of circular shafts, torsion of non-circular sections, membrane analogy, Propagation of waves in solid media. Applications of finite difference equations in elasticity

Theory of Plasticity:
Stress-strain diagram in simple tension, Perfectly elastic, Rigid - Perfectly plastic, Linear work - hardening, Elastic Perfectly plastic, Elastic Linear work hardening materials, Failure theories, yield conditions, stress - space representation of yield criteria through Westergard stress space, Tresca and Von-Mises criteria of yielding.
Plastic stress-strain relations, Saint Venant's Theory of Plastic flow, Elastic plastic Deformations, Prandtl's stress equations, Levy - Mises equation, Reuss theory of elastic - plastic deformation, Hencky's theory of small plastic deformations, Plastic potential, Flow Rule.

REFERENCE BOOKS:
Timoshenko and Goodier, Theory of elasticity, McGraw Hill Book Company, III Edition, 1983.
P. S. Hodge, Plastic Analysis of Structures, John Wiley and Sons.
J. Chakrabarthy, Theory of Plasticity, McGraw Hill, 1987.
Neal B. G., Plastic Methods of Structural Analysis, Chapmen and Hall, 1977, III Edition.
W. Johnson and P. B. Mellor, Plasticity for Mechanical Engineers, D.Van Nostrand Co. Ltd., 1962.
Oscar Haffman and George Sachs, Introduction to the Theory of Plasticity for Engineers, Mc,Graw Hill co.,
T. H. Lin, Theory of Inelastic structures, John Wiley and sons.
C. N. Massonnet, Plastic Analysis and Design of Plates, Shells and Discs, North Holland Publishing Co.
Beedle L. S., Plastic Design of Steel frames, John wiley & Sons 1961.
Y. C. Fung, Foundations of Solid Mechanics, Prentice-Hall.
S. Vallappan, Continuum Mechanics fundamentals, Oxford and IBH.
M. Kachanov, Theory of Plasticity, Mir publishers, Moscow.

09 CCS - 141 COMPUTER AIDED OPTIMUM DESIGN OF STRUCTURES

1. **INTRODUCTION:** Engineering applications, Statement of optimization problem, Classification of optimization problems, Optimization techniques.
2. **CLASSICAL OPTIMIZATION TECHNIQUES**: Single variable optimization, Multivariable optimization with no constrains, with equality constraints - Lagrange multiplier method, constrained variation method - and with inequality constraints Kuhn Tucker conditions.
3. **LINEAR PROGRAMMING**: Standard form of Linear programming problem, simplex method, revised simplex Method.
4. **NON LINEAR PROGRAMMING**: One dimensional minimisation methods, Elimination and Interpolation methods, unconstrained Optimization Techniques, Direct Search methods, Descent Methods, Constrained Optimization Techniques, Direct methods. Indirect methods.
5. **DYNAMIC PROGRAMMING:** Multistage decision processes, Concept of sub-optimization and principle of optimality, computation procedure in Dynamic Programming, Calculus method and tabular method of solution.
6. **STOCHASTIC PROGRAMMING:** for optimization of design of structural elements with random variables
7. **APPLICATION PROBLEMS :** Optimum design of RC, PSC, Steel structural elements

REFERENCE BOOKS:

S. S. Rao, Optimization - Theory and Applications, Wiley Eastern Limited, 1978.
R.L.Fox - Optimization Methods for Engineering Design, Addison Wesley, 1971.
R.M.Stark R.L.Nicholls, Mathematical Foundations for Design, McGraw Hill Book Company.
Narsingk Deo – System simulation with digital computer, Prentice – Hall of India Pvt, Ltd. New Delhi – 1989.

09 CHY - 11 APPLIED MATHEMATICS

1. **Complex Variables:** Analytic functions and their relation to velocity potential and stream function of potential flow – Conformal mapping techniques – Schwarz – Christoffel theorem and its application to fluid flow problems.

2. **Partial differential equations:** Solution of homogeneous linear PDE, non-linear equations, Numerical solutions (Elliptic, Parabolic and Hyperbolic).

3. **Optimization Techniques:** Introduction – Classification of optimization problems – Classical optimization – Linear programming- Simplex method – Revised simplex method – Dual simplex method – Transportation problem. Nonlinear programming**:** One–dimensional minimization method – Unconstrained optimization techniques – Direct search method and Descent methods – Constrained optimization methods – penalty function – Dynamic programming; Multi stage decision processes, principles of optimality computation procedures in Dynamic programming.

4. **Finite Element Techniques:** Introduction – Variational methods, the basic component- a single element; The overall problem, An assemblage of elements – Techniques for nonlinear analysis – Generalisation of the theory – Applications to Hydraulic and Water Resources problems.

5. **Integral Transforms:** Fourier and Laplace transforms and their inversion formulae; solution of partial differential equations by integral transforms.

TEXT BOOKS:
1. SI Gass: 'Linear Programming', McGraw Hill, Kogakusha, 1975
2. SS Rao: 'Optimisation : Theory and Applications', wiley Eastern, 1980.
3. L Mangasarian: 'Non-linear Programming' – TMH 1969.

REFERENCE BOOKS:
1. CS Desai & JF Abel: 'Introduction to the Finite Element Method' – Affiliated East – West Press, 1972
2. CS Desai: 'Elementary Finite Element Method', Prentice-Hall, 1979
3. IN Sneddon: 'Use of Integral Transforms', TMH, 1974.
4. PP Gupta: 'Integral tranforma', Kedanath Ramnath, Meerut, 1980
5. SF Borg: 'Matrix – Tensor methods in continuum Mechanics', Affiliated East – West Press, 1966
6. E. Kreyszig: 'Advances Engineering Methematics' Wiley Eastern, 1976
7. N. Levinson & RM Rodheffer: 'Complex V ariables', TMHm 1988.

09 CHY - 13 ADVANCED HYDRAULICS

Mechanics of Ideal Fluid Flow:
Introduction to basic definitions; Concept of stress Tensor, System and control volume. Reynolds' Transformation equation; Laws of conservation of mass, linear momentum and energy by integral and differential analysis – Principles of rotational flow, vorticity and Circulation – Velocity potential – kinetic energy of irrotational flow; boundary conditions — elementary pattern of 2-dimentional flows: 1) Uniform flow; 2) Source – sink 3) Vortex; combinations of elementary patterns – 1) Doublet, 2) Vortex Pair, 3) Flow past Half body, Rankine's body; circular cylinder with and without circulation.

Mechanics of Real Fluid Flow:
Difference between ideal and real fluid flows – Preliminary concepts of viscous flow phenomenon – Navier Stoke's equation and their general properties – exact and approximate solutions of Navier – Stoke's equation; Introduction to boundary layer concept – analysis of laminar flow – Stability of laminar flows and transition, turbulence – origin of turbulence – analysis of turbulent boundary layers.

TEXT BOOKS:
1. Fox and McDonald, " Introduction to fluid Mechanics", John Wiley
2. R. H. F. Rao, " Fluid Dynamics", Charles E Morn'll Books Inc. 1967

REFERENCE BOOKS:
1. I. H. Shames, "Mechanics of Fluids", McGraw Hill, 1962
2. Y. L. Steeter, "Fluid Dynamics", McGraw Hill, 1948
3. Vallentine - Hydrodynamics
4. S. W. Yuan – Fluid Mechancis

09 CCT - 13 ADVANCES IN CONSTRUCTION MATERIALS.

Concrete making materials-cement, aggregates, admixtures (both mineral and chemical). Microstructure of concrete, Fresh concrete and its rheology, Mechanical, deformational behaviour of hardened concrete. Laboratory testing of Concrete. Creep and Shrinkage of Concrete. Proportioning of Mixes- Normal Concrete, High Strength/Performance Concrete, Roller Compacted Concrete, Self Compacting Concrete and Reactive Powder Concrete. Durability of Plain and Reinforced Concrete. Types of Reinforcements. Corrosion of Reinforcing Steel- Electro-chemical process, measures of protection. Polymers, fibres, adhesives and sealants- types and their uses..

REFERENCE BOOKS:

1. Neville A. M. "Properties of Concrete" 4th Ed., Longman.
2. Mehta. P. K., and Paulo J. M. Monteiro, "Concrete- Microstructure, Properties, and Materials", (Indian Ed., Indian Concrete Institute), McGraw Hill.
3. Current Literature.

09 CCT - 241 CONSTRUCTION QUALITY AND SAFETY

Construction Quality, Inspection and Testing, Quality Control, Quality Assurance, Total Quality Management, Critical Factors of TQM; TQM in Projects, Benchmarking, concepts of quality policy, standards, manual, third party certification.

Safety laws and standards. Safety Hazards and cost effectiveness. Safety Management in Construction Industry- Safety rules in construction, Equipment Reliability considerations. Safety Budgeting.

REFERENCES BOOKS:

1. N. Logothetis, "Managing for Total Quality", Prentice Hall.
2. David Gold Smith, "Safety Management in Construction and Industry"
3. K. N. Vaid, "Construction Safety Management", NICMAR, Bombay.

09 CHT - 142 APPLIED STATISTICS AND COMPUTATIONAL METHODS

Statistical methods, scope and limitations, population and sample, frequency distribution and curves dispersion, standard deviation, co-efficient of variation, skewness.

Probability, Distributions properties and applications. Sampling distributions, methods, accuracy and applications in highway engineering problems. Statistical decisions, hypothesis testing errors, tests significance, variance Chi -square, test, confidence Interval.
Queueing theory. Time series analysis.

Variables scatter diagram Curve fitting methods, correlation linear regression multiple linear regression. Multivariate data analysis. Optimization technique and applications" in - Highway and traffic engineering problems.

Use of mathematical and statistical software packages.

REFERENCES BOOKS:

1. Snedecor G. W. and W.G. Cochran (1994). Statistical methods. East west press, India, 8th edition.
2. Medhi J (1982) Introduction to statistics. New age publications, New Delhi
3. Walpole R. E. and R. H. Mayers (1982): Probability and statistics for Engineers and Scientists.
4. Johnson R and G. Bhattacharya (1985): Statistics – principles and methods. John Wiley, N Y
5. Ross S. M. Probability and statistics for Engineers. Wiley Int. Edition
6. Alfredo H. S. Ang and Wah Tang (1975): Probability concepts in Engineering planning and design – vol –I (Basic principles) John Wiley and sons
7. Hannagth T. G. (1986): Mastering Statistics, 2nd edition, McMillan
8. Benjamin Jack R and Cornell C. Allen: Probability, Statistics and decisions for Civil Engineers, McGraw Hill Co.
9. Daroga Singh and F. S. Chaudhary (1986): Theory and Analysis of Sample Survey designs, New Age publications, ND
10. Agarwal B. L. (1988), Basic Statistics, 3rd Edition, New Age Pub. ND.

09 CIS - 12 APPLIED ELASTICITY PLASTICITY AND FRACTURE MECHANICS

Applied Elasticity: Definition and notation of components of stress and strain. Fundamental laws of theory of elasticity, Generalised Hooke's Law. Plane stress and plane strains, Stress and strain at a point, Differential equations of equilibrium, boundary condition and compatibility equations, Airy's stress functions, solution of two dimensional problems using polynomials, Saint Venant's principle, stress concentration, Solution in polar co-ordinates, Torsion of prismatic, Circular and rectangular bars, Prandtl's membrane analogy, Torsion of rolled profiles and thin open sections.

Plasticity: General concept, yield criteria, flow laws for perfectly plastic and strain hardening materials - simple applications, Elasto-plastic analysis for torsion and bending of bars, Theories of failure.

Fracture Mechanics: Introduction, Importance, Quasi brittle materials, nonlinear analysis, Review of concrete behaviour in tension and compression, Basic frameworks for modeling of quasibrittle materials, Linear Elastic Fracture Mechancis – Griffith and Irwin theories, Nonlinear Fracture Mechanics – Discrete crack concept/Smeared crack concept, Size effect, Plasticity models for concrete – Associated and non-associated flow, Failure surfaces for quasibrittle materials.

REFERENCE BOOKS:

1. Timosheko & Goodier "Theory of Elasticity" – 3rd Edition Mcgraw Hill – New York.
2. Valliappan S. "Continuum Mechanics Fundamentals" (1982), Oxford IBH, N D. New Delhi.
3. Venkataraman and Patel “Structural Mechanics with introduction to Elasticity and Plasticity” – Mcgraw Hill, 1990.
4. Shanes – “Introduction to Solid Mechanics – II Edition, PH, 1989.
5. Jirasek, M. and Bazant, Z. P., Inelastic analysis of structures, J. Wiley and Sons, New York, 2002.

6. Karihaloo, B.L., Fracture Mechanics and Structure Concrete, Concrete Design and Construction Series, Longman Scientific and Technical, 1995.
7. Shah, S.P., Swartz, S.E. and Ouyang, C., Fracture Mechanics of Concrete: Applications of Fracture Mechanics to Concrete, Rock, and other Quasi-battle materials, J. Wiley and Sons, New York, 1995.
8. T.G. Sitharam and L. Govinda Raju, "Applied Elasticity" – Interline Publishing, 2005.

09 CIS - 251 ADVANCED STRENGTH OF MATERIALS

Curved Beams: Introduction, Circumferential stress in a curved beam, Redial stresses in curved beams, Correction for circumferential stresses in curved beams having I, T, or similar cross sections, Deflections of curved beams, Statically indeterminate curved beams, Closed ring subjected to a concentrated load.

Nonsymmetrical Bending of Straight Beams: Definition of shear center in bending, Symmetrical and nonsymmetrical bending, Bending stresses in beams subjected to unsymmetrical bending, Deflections of straight beams subjected to unsymmetrical bending, Sensitivity of deep I sections.

Shear Center for Thin-Wall Beam Cross Sections: Approximation employed for shear in thin-wall beam cross sections, Shear flow in thin-wall beam cross sections, Shear center for a channel, I and angle sections.

Beams on Elastic Foundations: General theory, Infinite beam subjected to concentrated load, Boundary conditions, Infinite beam subjected to a distributed load segment, Semi-infinite beam subjected to loads at its end, Semi-infinite beam with concentrated load near its end, Short beams.

Stress Concentrations: Basic concepts, Nature of stress concentration problems. Stress concentration factors, Experimental techniques, Stress gradients due to concentrated load, The stationary crack, Crack propagation, Stress intensity factor, Effective stress concentration factors and applications

Method of Tension Co-efficient: General principles, Analysis of three-dimensional trusses and frames.

REFERENCE BOOKS:

1. Arthur P. Boresi and Omar M. Sidebottom: "Advanced Mechanics of Materials", Fourth Edition, John Wiley & Sons, 1985
2. James M. Gere and S. P. Thimoshenko: "Advanced Mechanics of Materials", Second Edition, CBS Publishers, New Delhi, 2000.
3. A. C. Ugural and S. K. Fenster, "Advanced Strength of material and Applied Elasticity", Arnold Publishers, 1981.
4. S. B. Junnarkar, "Mechanics of Structures", Volume - III, Charotar Publications, Anand, India

09 CGT - 142 GROUND IMPROVEMENT TECHNIQUES

Principles of ground improvement, Mechanical Modification, Principles of densification, Properties of Compacted soil, Compaction control testes, specification for compaction Hydraulic modification Dewatering systems, filtration, drainage and seepage control with Geosynthetics, Preloading and vertical drains, Electrokinetic dewatering, Chemical modification, modification by Admixtures, Admixtures in pavement design, stabilization using industrial wastes, Grouting Modification inclusion and Confinement; Soil reinforcements, flexible geosynthetic sheet reinforcements, Anchorage, Rock Bolting, soil nailing.

REFERENCE BOOKS:

1. Manfired R. H. "Engineering Principles of Ground Modification", McGraw-Hill Pub.Co.1990
2. Belt, "Methods of Treatment of Unstable Ground, Butterworths", 1975.
3. Koener R M., "Construction and Geotechnical Methods in Foundation Engineering"., McGraw Hill Pub Co New York, 1985
4. Hausmann M R "Engineering Principles of Ground Modifications", McGraw Hill Pub Co New York, 1990
5. Ingles O G and Metcalf J B., "Soil Stabilisation: Principles and practice", Butterworths, London, 1972
6. Ell F G., "Methods of Treatment of Unstable ground, Newness Butterworths, London, 1975
7. Nelson J D and Miller D J., "Expansive soils", John Wiley and sons. Inc new

09 MWR - 22 WATER SHED MANAGEMENT

Introduction, concept in watershed planning and development watershed and their types.

Hydrologic, processes, precipitation infiltration runoff methods of determination of hydrological data.

Water consedvation and recirculation measures: Farm ponds, design requirements and functional details.

Soil erosion, field practices in controlling erosion by water (methods of soil conservation) quantitative soil loss estimation.
Design and construction of contaru bonds graded, terraces and Vegeyative water courses.
Gully control vegetative measures, temporary semi-permanent and permanent structures for qualy control and reclamation and their design.

Desiiigin'g of levies, small dams and pick up weives, Nala bunding and percolation tanks on sniall streams (developments of irrigation resources from stearns.)

Developments of water shed programmes integrated area development and land use planning for siol and water conservation.

Watershed Modelling.

REFERENCE BOOKS:

1. Dragoun F. J and et al, "Flood Hydrology of small watersheds" ASAF – 1974
2. A. H. Micheal and T. P. Lojna "Principles of Agricultural Engineering vol.11, jin Broawers, New Delhi, 1965
3. M. S. V. Rao, "soil Conservation in India" – ICAR Publication.
4. Williams J.R. and et al, "Sediment Yield Prediction based on watershed hydrology", ASAE 1977
5. M. G. Anderson and T. P. Burt, "Hydrological Forcasting 1985 Johm Wiley and sons.
6. Jarren, Viessman et al "Introduction to hydrological" I.E.P. A Dun Donnelhey Publishers, N. Y.
7. P. Jayarami "Stochctic Hydrology" Reddy Laxmi Publications, Delhi.
8. R. Lal and E.W Russell, "Tropical Agricultural Hydrology: Watershed Management and Lana", John Wiley and Sons Publication.
9. 1)onal R. Satterlaund, "Wildland Watershed Management", John Wiley and Sons Publication.
10. Alansinghand G. R. Chowdary "Current Practices in Dry land Rsources and Technology (International Over Views) Vol. 1,2 and 3 Editions. Published by Scientific Publishers, Rataned Road, P.O. Box 91, Jodhpur – 342001.. (Raj)
11. Haan, C. T. et al, "Hydrological Modelling of small watersheds", An ASAE Mongiaph No. 5, Published by ASAE Technical series James A. Basselman (ed.)

09 CEE - 13 WASTEWATER TREATMENT ENGINEERING

Objectives of wastewater treatment. Composition, Properties and analysis of wastewater.

Microbiology of waste treatment – Growth and inhibition of bacteria. Kinetic of Biological growth, Batch culture substrate limited growth, Cell growth and substrate utilization, Effects of endogenous metabolism. Mano; d's and Michaclis menton kinetics and their applications. Determination of kinetic coefficients.

Fundamentals of process analysis, Reaction Kinetics, Mass balance analysis, Reactors and their hydraulic characteristics, Reaction kinetics and Reactor selection. (Batch, Plug flow, Completely stirred tank reactor and packed and fluidized bed reactor).
Sewerage System – Design of sanitary sewers and storm water sewers. Physical and Chemical treatment of wastewater, Screens, Comminuters, Grit chambers, Sedimentation, Chemical treatment.

Biological treatment process. Activated sludge process – Standard type and modifications. Aerators. Trickling filter, aerated lagoon, stabilization ponds. Treatment disposal of sludge – Sludge characteristics, concentration. Anaerobic sludge digestion. Aerobic sludge digestion, sludge conditioning, Dewatering and drying. Incineration and wet oxidation.

Testing Treatment units. Nitrogen conversion and removal. Forms, sources and operations and process for the control of nitrogen. Nitrification-Process, process analysis and their applications. Nitrogen removal by physical and chemical process-Air stripping of Ammonia and Ion exchange.

Phosphorous removal- Operations and process for phosphorous removal .

Rural Wastewater Systems.
Waste treatability studies – Bench scale and pilot scale, Effluent standards for discharge to water bodies and land applications – state and central.

REFERENCE BOOKS:

1. Metcalf and Eddy – Wastewater Engineering.
2. Webber W. J. Physico- Chemical Processes for water quality.
3. Fasir G. M., Geyer J.G. and Okun – Water wastewater engineering.
4. Eckenfelder and O' Conner – Biological Waste treatment.
5. Gaudy and Gaudy – Microbiology for Environmental Scientist and Engineers. McGraw Hill – 1980.
6. Gaudy – Advanced Wastewater treatment.
7. Ramalho- Advanced Wastewater treatments

LIST OF JOURNALS:

1. ASCE journal of Environmental Engineering
2. Journal of Water research
3. Indian Journal of Environmental Health
4. Energy Environment monitor.(Tata Energy research Institute)
5. Journal of Institution of Engineers (India) Environmental Division
6. Journal of Water, Environment Research (JWPCF)

09 CEE - 151 TRANSPORT PROCESS AND MODELING IN AQUATIC SYSTEMS

Models as Comprehensive tools in Environmental Management Diffusion and dispersion – Definition, Molecular turbulent and shear diffusion, Derivation of Fick's laws of diffusion and convective – diffusion equations for turbulent and shear flow regimes.

Steady state water quality modeling. Models for decaying pollutants (bacteria, phenol, ammonia) in rivers. 1-D Oxygen balance models –Streeter- phelps equation, critical point method. Data collection-specialized water quality surveys based on statistical average concepts. Estimation of parameters – decay and reareation rates. Calibration and verification of 1-D Oxygen model. Error measures. Mixing Zones in rivers – definition, steady state 2-D analysis with pipe and diffuser outfalls using solutions based on method of images for conservative and decaying pollutants field study methodology . Parameter estimation – Lateral Mixing co- efficient – critical point method – derivation and examples.

Dissolved Oxygen models for lakes under completely mixed and stratified conditions,

Ocean disposal of wastewater – siting and design of outfalls. Near field and far field mixing with simple examples.

Eutrophication models – simplified nutrient loading models for rivers and lakes.

Ground water quality modeling concepts – formulation of 1-D and 2-D models with decay and retardation for instantaneous sources, Non point sources of pollution, Analytical modeling for plume delineation studies from point sources. Field data gathering and parameter estimation.

Ecosystem model – Description, Schematization and formulation.

REFERENCE BOOKS:

1. Rich L. G. Environmental Systems Engineering McGraw Hill –1972.
2. Thoman R. V. – Systems Approach to water quality management McGraw Hill –1980.
3. Biswas A. K. – Models for water quality management – McGraw Hill 1980.
4. Rinaldi S. D.and Soncini, R- Modelling and Control of river water quality McGraw Hill –1979.
5. Gower A. M. – Water quality in catchment ecosystems john wiley – 1980.
6. Thomann and Mueller 1986., Principles of water quality management and control – Harper and Row pubs.
7. Hazen and Cherry, Ground Water Quality.
8. Velz L. Z. Applied Stream Sanitation.

Group II

09 CCS - 12 COMPUTATIONAL STRUCTURAL MECHANICS

1. Brief history of Structural Mechanics, Structural Systems, Degrees of Static and Kinematic indeterminacies, geometrical & Material Non Linearities, Concepts of Stiffness and Flexibility. Energy concepts in Structural Analysis, strain energies – Axial, Flexural & Shear - Real work and Complementary work – Principle of virtual displacement for a rigid body and deformable body – Principles of potential energy minimum potential energy, stationary complementary energy, minimum complementary energy Maxwell Bett's theorem of reciprocal displacement.
2. Analysis of Indeterminate beams and frames system approach (both flexibility & stiffness methods)
3. Relationship between element and system – transformation of information from system forces to element forces using equilibrium equations, transformation of information from system displacement to element displacement, contra gradient law, element stiffness and flexibility matrices, (bar, beam and grid elements), generation of system stiffness / flexibility matrix using uncoupled element stiffness / flexibility matrices. Analysis of statically indeterminate structures (i) Truss, (ii) Continuous beam & (iii) Simple frames by stiffness and flexibility approach (element approach)
4. Direct stiffness method local and global coordinate system – Direct assembly of element stiffness matrices – Analysis of indeterminate structures (i) Truss, (ii) Continuous beam & (iii) Simple frames.
5. Storage techniques – Half band, skyline storage. Equation solvers – Gauss elimination, Gauss – Siedel, Cholesky methods, Frontal solver. Numerical integration – Simpson, trapezoidal, Gaussian quadrature, Newmarks methods. Solution of Eigen value problems – solution of characteristics equations – Jacobi method. Solution of Differential equations up to second order by Runge – Kutta method and Finite difference method- Algorithms and flow charts

REFERENCE BOOKS:

S. Rajasekaran, "Computational Structural Mechanics", PHI, New Delhi 2001

C. S. Reddy, "Basic Structural Analysis," TMH, New Delhi 2001

F. W. Beaufait et al., Computer Methods of Structural Analysis, Prentice Hall, 1970.

W. Weaver and J. H. Gere., Matrix Analysis of Framed Structures, Van Nastran, 1980.

H. Karde Stuncer, Elementary Matrix Analysis of Structures, McGraw-Hill 1974.

A.K. Jain Advanced Structural Analysis with Computer Application Nemchand and Brothers, Roorkee, India

M. F. Rubinstein Matrix Computer Methods of Structural Analysis Prentice-Hall.

O. C. Zienkiewica, The Finite Element Method, TMH, India.

C. S. Krishnamoorthy Finite Element theory and programming TMH, India.

K. J. Bathe, Finite element procedures in Engineering Analysis. PHI. New Delhi

09 CCS - 241 EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

1. **SEISMIC HAZARD ASSESSMENT** – Engineering Seismology – Definitions, Intruduction to Seismic hazard , Earthquake phenomenon – Seismotectonics and seismic zoning of India – Earthquake monitoring and seismic instrumentation – Characteristics of strong Earthquake motion - Estimation of Earthquake parameters – Microzonation

2. **EARTHQUQKE EFFECTS ON STRUCTURES:** Response to ground acceleration – response analysis by mode superposition – torsional response of buildings -response spectrum analysis – selection of design earthquake – earthquake response of base isolated buildings – earthquake response of inelastic structures, allowable ductility demand Response Spectra / Average response Spectra - Design Response Spectra - Evaluation of earthquake forces – (IS 1893 – 2002). – Effect of earthquake of on different types of structures – Lesson learnt from past earthquakes.

3. **GEOTECHNICAL EARTHQUAKE ENGINEERING:** Soil Dynamics – Geotechnical failure of foundations during earthquake – Earthquake Resistant design of Shallow foundation – Liquefaction and Remedial measures

4. **CONCEPTS OF EARTHQUAKE RESISTANT DESIGN:** Structural Systems / Types of buildings – Causes of damage – Planning consideration / Architectural Concept (IS 4326 – 1993) (Do's and Donts for protection of life and property) – Philosophy and principle of earthquake resistance design – Guidelines for Earthquake Resistant Design –

5. **EARTHQUAKE RESISTANT EARTHEN BUILDINGS (IS 13827 – 1993).** – Earthquake Resistant low strength masonry buildings

6. **EARTHQUAKE RESISTANT DESIGN OF MASONRY BUILDINGS** – Strength and Structural properties of masonry – lateral load - Design considerations

7. **EARTHQUAKE RESISTANT DESIGN OF RCC BUILDINGS** – Material properties – lateral load analysis – design and detailing (IS 13920 – 1993).

8. **SEISMIC BASE ISOLATION:** Basic concept of seismic base isolation – Seismic Isolation systems.

REFERENCE BOOKS:

Chopra, A. K. "Dynamics of structures", Prentice-Hall of India Pvt. Ltd. New Delhi.
Clough, R. W. and Penzien J, "Dynamics of Structures", McGraw Hill Book Co. New York
Biggs, M. "An Introduction to Structural Dynamics", McGraw Hill Book Co. New York
Ghose, S. K. "Earthquake Resistance Design of Concrete Structures", SDCPL – R&D Center – New Mumbai 73.
Jaikrishna et al. "Elements of Earthquake Engineering", South Asia Publishers, New Delhi.
PAZ M. "Structural Dynamics", CBS Publishers, New Delhi.
Humar, J.C. "Dynamics of Structures", Prentice-Hall, New Jersey.
James L Stratta, "Manual of Seismic Design", Pearson Education (Singapore) Pte, Ltd., Indian Branch Delhi - 2004

09 CHY - 21 WATER RESOURCES PLANNING, DESIGN & MANAGEMENT

Water Resources Development: Water resources of India, necessities of harnessing them; Importance of irrigation, power and other projects. Water requirements- basic knowledge of structures and machinery involved, project plan, multipurpose projects, concepts of systems approach, environmental problems, large v/s small projects, water rights, river disputes.
Investigations : The catchment, water availability, data collection – rainfall stream flow, evaporation, water table, catchment characteristics- land use and soil data; Geomorphology – channel network, order, length and drainage density.

Stochastic Modelling : Time series, Stochastic analysis- components, trend analysis, periodicity and its modeling, stochastic generation – random number generation, autoregressive and moving average models, periodic models, daily flow and rainfall models. Calibration, validation and applications, reservoir capacity.

Regional Analysis: Rainfall frequencies, PMP, *PMF*, joint and marginal distribution, reliability studies; principal component analysis – applications to management problems; conjunctive use.

Design Flood: Definition: Methods of calculation and probability studies; empirical formulae, unit hydrographs, correlation models, quasi- physically based models; flood forecasting.

Flood Routing: Definition, methods of reservoir and channel routing.

Reservoir and Seduyientation: Calculation of erosion and sediment yield, reservoir life, sediment control, silt removal.

TEXT BOOKS:

1. Chaturvedi M. C., “Water Resources Systems Planning and Management”, Tatal McGraw Hill, 1987
2. James, L. D., and Lee R.R., “Economics of Water Resources Planning”, McGraw Hill 1987
3. Mutreja, K. N., “Applied Hydrology”, Tata McGraw Hill, 1988

REFFERENCE BOOKS:

1. Chow, Y. T.(Ed), “ Handbook of Hydrology”, McGraw Hill, 1988
2. Chow, Y. T. and others “Applied Hydrology”, McGraw Hill
3. Hann C. T., “Statistical methods in Hydrology”, A.E.W. Press, 1977
4. Subramanya K, “Engineering Hydrology”, Tata McGraw Hill
5. K. L. Rao, “Water Wealth of India”

09 CCT - 152 STRUCTURAL MASONRY

Introduction to Masonry structures, Materials for Masonry, Strength and elastic properties of masonry, Parameters influencing Masonry properties, Behaviour of masonry under shear, flexure, and axial loads (static and dynamic), Design of masonry structures, Masonry arches and Shells, Introduction to Reinforced Masonry

REFERENCE BOOKS:

1. Hendry A W, "Structural Brick Work", Mac Millan Press.
2. Sven Sahlin, "Structural Masonry", Prentice Hall, New Delhi.
3. Curtin, "Design of Reinforced and Pre-stressed Masonry", Thomas Telford.
4. Dayaratnam P, "Brick and Reinforced Brick Structures", Oxford and IBH, New Delhi.

09 CCT - 21 CONSTRUCTION ECONOMICS AND FINANCE

Engineering economics, Time value of money, discounted cash flow, NPV, ROR, Bases of comparison, Incremental analysis, Benefit-Cost analysis, Replacement analysis, Breakeven analysis, Risks and uncertainties and management decision in capital budgeting, Taxation and Inflation, Working capital management,

Construction accounting, Income statement, Financial statements, Appraisal through financial statements-ratio's analysis, Long term Financing, Practical problems and case studies.

REFERENCE BOOKS:

1. Courtland A. Collier and William B. Ledbetter, "Engineering Economics and Cost Analysis", Harper & Row.
2. Kuchal S.C, "Financial Management"
3. Van Horne J. C, "Fundamentals of Financial Management"

09 CHT - 241 SPECIAL PROBLEMS IN ROAD CONSTRUCTION

Problems on construction on areas with marshy and weak soils, expansive clays and' water- logged - areas. Various effective measures for solving the problems, machinery required and method of construction. Control of water logged areas and seepage flow within the sub grade. Design and construction of filter drains and capillary cut-off.

Methods of strengthening weak foundation soil, acceleration of consolidation and settlement of compressible embankment foundation, Vertical sand drains - application, design and construction method.

Use of special materials such as geo-synthetics and special construction, technique such as reinforced earth.
Road construction on desert region and coastal areas, alternative methods, road construction on high altitudes, hilly and mountainous terrain.

REFERENCES BOOKS:

1. DSIR "Soil Mechanics for Road Engineers" – HMSO, London, 1954.
2. Leonards G. A. "Foundation engineering" - McGraw Hill Book Company, New York, 1962.
3. Cedgreen H. R. "Drainage of highway and airfield pavement" - John Willey and Sons. Inc., New York, 1974.
4. G. Kassiff M. Livnet. G. Wisemen "Pavements on Expansive clays" – Jerusalem Academy Press, Jerusalem. Israel, 1969.
5. R. D. Krebs & R. D. Walker "Highway Materials" - McGraw Hill Book House, New York, 1971.
6. R. M. Koerner "Designing with Geosynthetics", 4th Edition Prentice Hall, New Jerssey, 1997.
7. IRC-75 "Guidelines for the design of High embankments" IRC, 1979.
8. IRC - Relevant IRC publications

09 CGT - 143 ADVANCED PAVEMENT DESIGN

Introduction – Components of pavement structure, Importance of subgrade soil properties on pavement performance – Functions of subgrade. Subbase. Base course and wearing course – True approach of pavement design. Stresses in flexible pavements – Stresses in homogeneous mass and layered systems deflections, shear failures, equivalent wheel and axle loads.

Elements in design of flexible pavements – Loading characteristics – Static, Impact and Repeated loads, Effects and tandem axles. Area of contact and type pressure- Modulus or CBR value of different layers – Equivalent single wheel load, Equivalent stress and equivalent deflection criteria, Equivalent wheel load factors – Climatic and environmental factors.

Design methods for flexible pavements- Group index method, California Bearing Ratio (CBR) adopted in various countries, Wyoming Method North Dakota Cone method, US Navy Method. Triaxial method. Stabilometer method. Mcleod method Benelmam Beam method. Current IRC guide lines.
Rigid pavements- wheel load stress, Elastic soil subgrade, westegaard analysis, Bradbury's approach. Arlington test. Pickett's corner load theory and charts for liquid, Elastic and solid of inite and infinite depth of subgrade.

Temperature Stresses- Thermal properties of aggregates and concrete, Effects of temperature variation on concrete pavements, Westergaard's and Tomlinson's analysis of warping stress.

Design of rigid pavements- Portlant cement association and AASHO methods, Introduction of design and construction of reinforced concrete and prestressed concrete pavements. Current IRC guide lines for rigid pavements.

Pavement Evaluation and Maintenance – Condition and evaluation survey. Structural evaluation of flexible and rigid pavements. Binding quality of pavements. Serviceability pavement maintenance strategy.

REFERENCE BOOKS:

1. Yoder E.J. and Witezok M.W., "Principles of pavement design" Wiley international.
2. Yang, "Design of Functional Pavements"- McGraw Hill.
3. IRC Publication, "Guidelines for Design of Flexible pavement for Highways"-IRC37-1970
4. IRC Publication, "Guide lines for the Design of Rigid Pavement for Highwayd"-IRC58-1974

09 GIT - 141 PHOTOGRAMMETRY, GEODESY AND GPS

Objective:

On completion of this subject, students should have a sound knowledge about the database concepts, database management systems and their applications in GIS and modeling the real world.

1. **Database and Database Users:** Introduction, characteristics of database approach, intended uses of a DBMS, implications of database approach.

2. **Database System Concepts and Architecture:** Data models, schemas and instances, DBMS architecture and data independence, database languages and interfaces, database system environment, classification of database management systems.

3. **Data Modeling:** High level conceptual data models for database design, ER model concepts, schema constructs and simple applications.

4. **Record Storage and Primary File Organizations:** Secondary storage devices, buffering of blocks, placing file records on disk, operations on files – heap files and sorted files – hashing techniques.

5. **Index Structure of Files:** Single-level and multilevel ordered indexes, dynamic multilevel indexes using B-trees and B+ trees.

6. **Relational Data Model:** Concepts and constraints, update operations on relations, relational algebra, simple examples.

7. **Structured Query Language:** Data definition in SQL, queries, update statements, views in SQL, simple examples. Introduction and basics of Relation Database Management System.

8. **Database design:** Functional dependencies and normalization for relational databases, Normal forms based on primary keys, general definition of second and third normal forms, Boyce-Codd normal form.

9. **Query Processing:** Basic algorithms for executing query operations.

10. **Transaction Processing Concepts:** Introduction, transaction and system concepts, properties, schedules and recoverability.

11. **Concurrency and Recovery:** Locking techniques for concurrency control, recovery concepts and techniques.

12. **New Applications:** Discussion on new applications like Decision Support System, Data Mining, Data Warehousing and Spatial Databases, Recent Developments.

TEXT BOOK:

Elmasri R and Navathe S B., "Fundamentals of Database Systems", Benjamin / Cummings Publishing Co. Inc. (Addison-Wesley world student series), 2002.

REFERENCES:

Trembley J P and Sirenson P G., "An Introduction to Data Structures with Applications", Tata McGraw-Hill.

Date C J, "An Introduction to Database Systems", Vol-I, Addison-Wesley.

A Silberschatz, H F Korth and S Sudarshan, "Database System Concepts", McGraw-Hill International Editions, Computer Science Series.

09 CHY-22 GROUND WATER HYDROLOGY

1. Introduction, importance, occurrence, storage and conduit function of rocks, zones of aeration & saturation.
2. Aquifers, Aquifer properties, parameters.
3. Flow through porous medium, all basic equations.
4. Well hydraulics – confined, unconfined, leaky aquifers
5. Hydrogeology, Geophysical surveys, well design and pumping, utilization and depletion
6. GW recharge and legislation, Artificial recharge, ground water assessment, resources in India and Karnataka
7. Modelling ground water flow – numerical models, calibration and validation in detail, with examples.
8. Chemistry and pollution of Ground Water, preventive measures

TEXT BOOKS:

1. W.C. Walton " Ground water Resources Evaluation : Mc Graw Hill, Kogakusha, 1970
2. H. Boluwer, " Ground water Hydrology" Mc Graw Hill, Kogakusha, 1979
3. D.K.Todd, "Ground water Hydrology" John Wiley, 1959

REFERENCE BOOKS:

1. R.J.M. De Wiest, "Geohydrology", John Wiley, 1967
2. A Vermj it, " Theory of Groundwater Flow" MaeMillan, 1970
3. M.E.Harr, " Groundwater and Seepage" McGraw Hill
4. Raghunath K.M. " Ground Water", Wiley Eastern.
5. Karanth, " Ground Water assessment development and management", TMGH, 1987.

09 CEE - 153 ENERGY & ENVIRONMENT

Introduction: Global energy, Environmental resources, energy needs, energy crisis.

Indian scenario – Energy consumption, needs and crisis.

Energy production , utilization, Laws and Principles

Renewable sources of energy and Environmental aspects – Bio gas, Bio- Mass,

Hydro power, ocean energy, solar energy, agricultural waste derived energy.

Urban waste derived energy, wind energy.

Non renewable sources of energy and Environmental aspects – energy from coal, oil , natural gas, Nuclear energy, geothermal energy.

Global temperature, Green house effects, global warming.

Acid rain – Causes, effects and control methods.

Regional impacts of temperature change.

REFERENCE BOOKS:

1. Wilber L.C. "Hand book of Energy Systems" Engg Wiley and Sons 1989
2. Masten G.M. "Introduction to Environmental Engg and Science"
3. Sincero and Sincero, Environmental Engg – A design approach, Prentice Hall of India (1999)
4. Rao and Parulekar B.B. Energy Technology- Non-conventional Renewable and Conventional, Second Edition Khanna Publication 1997.

09 CEE - 21 ATMOSPHERIC ENVIRONMENTAL POLLUTION AND CONTROL

Introduction – Definitions, Different Classification of air pollution sources, emission inventory classification Case histories of Air Pollution Episodes, Air Pollution Laws, Characterization and sampling of atmospheric pollutants (Sampling train)

Monitoring of particulates, Procedures, carbon monoxides, Hydrocarbons, Oxides of Sulphur and Oxides of Nitrogen as per CPCB.

Analytical methods for quantifying particulates, organic vapours and metals of environmental concern.

Effects of Air Pollutants on materials and human health and injury to vegetation, National ambient Air quality standards, criteria and indices, Air Pollutant laws.
Meteorology- Composition and structure of the atmosphere, wind circulation, solar radiation, adiabatic lapse rate, ELR, Atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature inversions, wind rose diagram, General Characteristics of stack emission, plume behavior, Heat island effect, effect of terrain on plume behaviours .

Air Quality Modeling: Fixed box modies, Gaussian Dispersion model, plume rise, stack design, Maximum Ground level Pollutant concentrations, Concentrations along plume line, calculation of effective stack height, Down wind pollutant concentrations under Temperature inversion.

Particulates: Collection mechanism and efficiency, deposition of particulates from stacks, Hood and Duct design.

Particulate Pollution Control equipment – Design considerations of setting chambers, Cyclone separators, Wet collectors, Fabric filters, Electrostatic precipitators.

General Control of gases and vapours- Adsorption and Absorption processes and their kinetics, Basic design of a packed bed absorption tower.

General control methods to reduce sulphur dioxide emissions from fossil fuel .

Hydrocarbons in atmospheric photochemistry, Oxidents in Photochemical smog.
Noise- Definition, measurements, Sources, effects, occupational hazards. Addition of noise levels, CPCB standards, Leq. Ld. Ln, Ldn, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, Noise control at source, along its path and at receiver. Legal aspects of noise.

REFERENCE BOOKS:

1. Perkins – Air Pollution
2. Sterm – Air Pollution Vol 1. II, III.
3. Kenneth Wark and Cecil F Warner – Air Pollution – its origin and control, Harper and Row, Publishers, New York.
4. Environmental Engineers Hand Book , Edition- Liptak Chilton Book Co. USA
5. Magill, Holden and Ackley – Air Pollution hand book.
6. Sterm A.C. (ed) Vol. V- Air Quality Management.
7. Seinfeld N.J. – Air Pollution McGraw Hill 1975.

LIST OF JOURNALS:

- Journal of Air Pollution control Assoc, New York.
- Asian Environment, Philippines.
- Industrial Engineering Chemistry Journal
- Canadian Journal of Chemical Engineering
- American Institute of Chemical Engineering Journal.

09 CEE - 23 ECOLOGY & ENVIRONMENTAL IMPACT ASSESSMENT

Ecology: Classification of Ecosystem, terminology concepts of Ecology. Sub-divisons in Ecology. Biotic and Abiotic components, Structure and functions of ecosystems. Energy flow in Ecosystems. Measurement of primary production. Ecological Niche and succession. Population Ecology community Ecology, Habitat Ecology. Biogeochemical cycles, Ecological pyramids.

Aquatic and Terrestrial Ecosystems, Dominance and Diversity Indices Adaptations, Biogeography, Systems Ecology and Ecosystem modellling.
Oligotrophy, Eutrophic status, Nutrient enrichment – Analysis of Eutrophication – Vollenweider and Dillon models of Phosphorous loading on lakes. Control of Eutrophication.
Environmental Impact Assessment: Developmental Activity and Ecological factors. EIA, EIS, FONSI, Need for EIA Studies, Base line information, Step – by-step procedure for conducting EIA, limitations of EIA.
Frame work of Impact Assessment, development projects in environmental setting. Objective and scope of EIA. Contents of EIA, Methodologies, techniques of EIA.

Assessment and Prediction of impacts on Attributes air, water, noise, land, ecology soil, cultural and socio-economic environment, IAA guidelines for development projects, REIA-CEIA.

Public participation in environmental decision making. Practical considerations in preparing Environmental Impact Assessment and Statements.

Salient features of the project activity – Environmental parameter – Activity relationships – matrices.
EIA for water resource development projects, Nuclear power plant project, Mining project (Coal, Aluminium, iron ore, Bauxite) Thermal Power Plant (Coal-based) project, Pharmaceutical industries, etc.

REFERENCE BOOKS:

1. Odum – Fundamentals of Ecology – Addition Co.
2. Kormondy – Concepts of Ecology – Printce hall publication.
3. Anantakrishnaan T. N – Bio-resources Escology – Oxford and IBM.
4. Krebs J. – Ecology – The experimental analsis of distribution and abundance-II Edition Harper international.
5. Momm R.E. (ed) Environmental Impact Assessment John Willey.
6. Canter L – Environmental Impact Assessment McGraw Hill 1977.
7. Clark B. C.. Bisett and Tomlinsan P – Perspective on environmental Impact Assessment – Allied Publishers – 1985
8. Mall C.A.S. and Day J.W – Ecosystem modeling in theory and practice: An introduction with case NI stories – John Willey.
9. Heer and Hagerty, Environmental Impact Assessment and statements. Van Nostrand and Reinhold Co. 1977.
10. Jain, et al Environmental Impact Assessment. Van Nostrand.

LIST OF JOURNALS:

1. Journal of Urban Planning and Development
2. Journal Ecology - Bombay
3. Journal of Ecology.

Group III

09 CCS - 13 COMPUTATIONAL STRUCTURAL DYNAMICS

1. Single degree of freedom system- degrees of freedom, undamped system, springs in parallel or in series, Newton's law of motion, free body diagram, D'Alembert's principle, solution of the differential equation of motion, frequency and period, amplitude of motion. Damped Single degree of freedom system – viscous damping, equation of motion, critically damped system, overdamped system, underdamped system, logarithmic decrement. Response of one degree of freedom system to harmonic loading – undamped harmonic excitation, damped harmonic excitation, evaluation of damping at resonance, bandwidth method (Half power) to evaluate damping, response to support motion, force transmitted to the foundation, seismic instruments.
2. Response to general dynamic loading – Impulsive loading and Duhamel's integral, numerical evaluation of Duhamel's integral, undamped system, numerical evaluation of Duhamel's integral, damped system. Fourier analysis and response in frequency domain – fourier analysis, fourier co-efficients for piece-wise liner functions, exponential form of fourier series, discrete fourier analysis, fast fourier transform.
3. Generalised co-ordinates and Rayleigh's method – principle of virtual work, generalised single degree of freedom system (rigid body and distributed elasticity), Rayligh's method. Hamilton's principle
4. Non-liner structural response – non-liner SDOF model, liner acceleration step by step method, elastoplastic behavior, algorithm for the step by step solution for elastoplastic SDOF system. Response spectra – construction of a response spectrum, response spectrum for support disturbance tripartite response spectra, response spectra for inelastic design.
5. Multistory shear building. Free vibration – natural frequencies and normal modes. Forced motion – modal superposition method – response of a shear building to base motion. Damped motion of shear building – equations of motions – uncoupled damped equation – conditions for damping uncoupling.
6. Dynamic analysis of beams – stiffness matrix, mass matrix (lumped and consistent) equations of motions for the discritiesed beam in matrix form and its solutions.
7. Non-liner response of MDOF systems – incremental equation of motion, Wilson-θ method.
8. Introduction to random vibration – random functions, normal and Rayleigh's distribution, correlation, fourier transform, spectral analysis, spectral density function, response to random excitation.

REFERENCE BOOKS:

1. Mario Paz, "structural dynamics, Theory and computation", 2nd Edition, CBS Publisher and Distributers, New Delhi.
2. Ray W Clough and J Penzien, "Dynamics of Structures", 2nd Edition, McGraw-Hill, New Delhi.
3. Mukopadyaya, "Vibration, Dynamics and structural problems," Oxford IBH Publishers New Delhi.

09 CCS - 251 RELIABILITY ANALYSIS AND RELIABILITY BASED DESIGN OF STRUCTURES

1. Concept of variability in design parameters, Applications of Statistical principles to deal with randomness in basic variables, statistical parameters and their significance,
2. Characteristic strength and characteristic load, probability modeling of strength, geometrical dimensions, material properties and loading. Description of various probability distributions – Binomial, Poisson, Normal, Log-Normal, Beta, Gama, distributions.
3. Testing of goodness – of – fit of distributions to the actual data using chi-square method and K.S Method.
4. Statistical regression and correlation using least – square and chi – square methods,
5. Statistical Quality control in Civil Engineering, - Application problems
6. Mean value method and its applications in structural designs, statistical inference, Comparison of various acceptance and rejection testing.
7. The Random variable, operation on one Random variable, expectation, multiple random variables, reliability distributions – basic formulation, the hazard function, , Weibull distribution. Introduction to safety assessment of structures – reliability analysis using mean value theorem – I, II and III order Reliability formats.
8. Simulation techniques, reliability index - reliability formulation in various limit states, reliability based design, application to design of RC, PSC and steel structural elements.

REFERENCE BOOKS:

John B. Kennedy and Adam M. Neville, Basic Statstical Methods for Engineers and Scientists, Harper and Row Publishers, New York.

Murray R. Spiegel, Theory and Problems of Probability and Statistics, Schaums, Outline series – New York.

Ang A. H. S and W. H. Tang, Probability concepts in Engineering planning and Design, John Wiley and sons, New York, Vol.I and II.

R. Ranganthan, Reliability Analysis and Design of Structures, Tata McGraw Hill publishing Co. Ltd., New Delhi.

K. C. Kapoor, “Reliability in Engineering Design”, John Wiley and Sons, New York

J. N. Siddall, “Probabilistic Engineering Design”, Marcel Decker, New York.

09 CHY - 242 CLOSED CONDUIT FLOW

Pipes – Hydraulic of pressure flow. Steady state Darcy’s equation for flow thro’ pipes. Analysis and design of pipe systems like pipes in series and parallel. Design of pipes.

Pipe networks - Analysis and design using various methods. Use of softwares in design. Practical examples, difficulties and solutions. Flow measurements. Concepts of unsteady flow - Basic differential equations of unsteady flow in closed conduits – Solutions by method of characteristics – Algebraic and graphical water hammer. Additional boundary conditions and systems elements. Methods for controlling transients in closed conduits.

TEXT BOOKS:

1. RW Fox & McDonald AT – Introduction to Fluid Mechanics', John Wiley, 1978
2. SW Yuan – 'Foundations of Fluid Mechanics', Prentice-Hall (India), 1969

REFERENCE BOOKS:

1. Fluid Mechanics – Feather Stone and Nalluir
2. Hydraulic transients – streeter.
3. Fluid Mechanics –Wiley & Streeter

09 CCT - 153 REHABILITATION OF STRUCTURES

Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, experimental investigations using NDT, load testing, corrosion mapping, core drilling and other instrumental methods, Different materials for repair, Different methods of repair of concrete structures, damage control, emergency repairs etc.

REFERENCE BOOKS:

1. Sidney., M. Johnson "Deterioration, Maintenance and Repair of Structures"
2. R.N. Raikar "Rehabilitation of Structures", Edited by, Vol. 1, 2 and 3, Proc., Int. Symposium, Maharashtra Indian Chapter of ACI, Bombay.
3. IS Codes and other codes.
4. Current Literature.

09 CHT - 153 RURAL ROADS

Problems associated with planning, design and construction of rural roads low.
volume rural roads in India. Rural road network planning.

Utilization of locally available materials and waste materials in rural road projects.

Principle, scope and construction method of various soil stabilization techniques in rural roads. properties and specifications of materials for village/low volume rural road projects

Design, construction, and maintenance aspects, by resorting to appropriate technology. Use of rural road.

REFERENCES BOOKS:

1. HMSO, "Soil Mechanics for Road Engineers", Her Majesty's Stationary Office, London.
2. IRC, Manual for Rural Roads, Indian Roads Congress, 2002.
3. Relevant IRC Publications
4. PIARC, International Road Maintenance Hand Book- Maintenance of Paved Roads, France
5. PIARC, International Road Maintenance Hand Book- Maintenance of Unpaved Roads, France.

09 CIS - 141 SAFETY OF STRUCTURES

Concepts of Structural Safety: Design methods – Permissible Stress Method, Ultimate Load Method, Limit State Method, Deterministic and Probabilitic design methods.
Basic statistics – Mean, Median, Mode, Standard Deviation, Coefficient of variation, Sample correlation.
Basic Probability, Function of Random variables, Moments and Expectations, Common Probability Distributions – Gaussian, Log-normal and Extremal Distributions.
Basic Structural Reliability – Computation of Structural reliability, Monte Carlo method and its application.
Reliability theory and structural reliability, Introduction to levels of reliability analysis - level 1, 2 and 3. Basic features of level 2 methods - characteristics of load and resistance - FOSM and AFOSM methods of reliability assessment. Normal / Non-normal variables, Determination of reliability index for present design, Determination of partial safety factors.

REFERENCE BOOKS:

1. Ranganathan, R. "Reliability analysis and Design of Structures 'THM 1990.
2. Augustic Barrata and Casciati "Probabilistic methods in structural engineering" Chapman and Hall - 1986.
3. Benjamin and Cornell "Probability statistics and decision or civil engineering "Mc Graw Hill - 1970.
4. Melchers "Structural reliability analysis and prediction" John Wiley & Sons - 1987.
5. Clerke A.B. and Converman S.H. "Structural shell work -Limit state design" Chapman and Hall. 1987.
6. Mac Gregor "Reinforced concrete Mechanics and Design" Prentice Hall - 1988.
7. Evans and Kong "Reinforced and prestressed Concrete" ELBS.
8. Neal Plastic method of Structural Analysis Chapman and Hall.
9. Louis F. Geschwinder, Robert O. Disque, Reider B. Jorhovde "Load and Resistance factor design factors design of Steel Structures" Printice Hall Publication 11994.
10. Rokach A. J. "Schame's Outline of theory and problems of structural Steel Design - Load and Resistance Factor Method".

09 CIS - 152 OPTIMIZATION

Introduction: Design Variables, objective function, constraints, statement of an optimization problem, optimization techniques.

Classical optimization techniques: Single Variable optimization, multivariable optimization with no constraints, with equality and inequality constraints.

Linear Programming: Standard form of linear programming problem, simplex method, pivotal reduction of general systems of equations, simplex algorithm, two phase simplex method.
Non-linear programming: Unconstrained optimization techniques - Descent methods, gradient of function, steepest descent method, variable metric method (Deviation-Fletcher-Powell method)

Non-linear programming: Constrained optimization techniques : penalty function methods, sequential unconstrained minimization techniques, sequential linear programming.

Dynamic programming: Multistage decision processes, concept of sub optimization and principle of optimality computational procedure.

Optimization of structures: Formulation of constraints and objective function for structural design problems, optimal design of trusses, frames and reinforced concrete framed structures, use of computer programs for structural optimization.

REFERENCE BOOKS:

1. S. S. Rao "Optimization theory and applications"
2. R.H. Gallagher & O.C. Zienkieuricza "Optimization in Structural Design".
3. U. Kirseh "Optimization Structural Design".
4. S. S. Bhavikatti, Structural Optimization using S. L. P. - Vikas Publishing House Pvt. Ltd.

09 CGT - 151 ENVIRONMENTAL GEO-TECHNIQUES

Source, Production and Classification of Wastes; Soil Pollution Processes Physical-chemical and Biological Interaction in Soil, Effects on geotechnical Properties and case studies; Waste Disposal Facilities such as Landfills and Impediments, Slurry Walls, etc., Barrier systems-Basic concepts, design and construction, stability, compatibility and performance; contaminant Transformations and Transport in subsurface, Monitoring sub surface contamination; Stabilization/Solidification of wastes; Reuse of waste Materials Contaminated site remediation.

REFERENCE BOOKS:

1. Daniel, D.E. Geotechnical practice for Waste Disposal, chapman and Hall, London, 1993
2. Rowe, R.K. Quigley R.M. and Booker, Clay Barrier systems for waste disposal facilities, J.R.E. & FN Spon, London, 1995.
3. Reddi, L.N. and lnyang, H.F. Geo environmental Engineering-Principles and Applications Marcel Dekker, Inc. 2000.
4. Bagchi, A. Design, Construction and Monitoring of Landfills, John Wiley & Sons, Inc. New York, 1994.
5. Sharma H.D. and Lewis, S.P. Waste Containment systems, Waste stabilization and landfills: Design and evaluation, John Wiley & sons, Inc. New York, 1994

09 GIT - 241 APPLICATIONS OF GEO-INFORMATICS FOR NATURAL RESOURCES MANAGEMENT

Objectives:

Developing skills in utilization of technologies of remote sensing, GIS, GPS etc for natural resources management and environmental studies

1. **Agriculture & Soil**
   Principle & approaches of crop inventory, crop production forecasting and crop stress detection; satellite agro-meteorology; Thermal & Microwave application in agricultural water management; soil survey/soil mapping and soil classification.

2. **Forestry & Ecology:**
   Forest cover type mapping, density assessment and quantitative measurements; deforestation / afforestation / encroachment mapping.

3. **Geosciences:**
   Principles of geomorphologic analysis, different genetic landforms, their identification; Applied geomorphology; Identification and mapping of various rock types and structural elements; Applied aspects of geology, engineering geology, Geo-technical, geo-environmental etc.

4. **Water Resources:**
   Surface water resources mapping and management; groundwater prospective zone mapping, ground water development and management; Quality assessment and estimation.

5. **Irrigation and watershed management:**
   Mapping and monitoring of catchments and command areas, watershed prioritization, location of water harvesting structures, soil erosion studies.

6. **Land Use / Land cover:**
   Land use / land Cover mapping, monitoring and management.

7. **Oceanographic studies:**
   Physical applications - Estimation of wind velocity & direction, sea surface temperature, upwelling, mixed layer depth, salinity, etc; identification & monitoring of Coastal habitat (Mangrove, Coral reefs, wet lands etc); Biological applications – Phytoplankton mapping, Suspended Sediment concentration mapping; Coastal Bathymetry; Integrated Coastal Zone Management.

8. **Meteorology applications:**
   Estimation of weather and climate parameters, and modeling aspects, global climatology.

9. **Disaster management:**
   Types of disaster: natural/ manmade (Flood, Drought, Landslide, Earthquake, Coal fire, Forest fire etc.), mitigation measures, methods for pre and post disaster management.

10. **Indian and International Case Studies:**
    Integrated Mission for Sustainable Development (IMSD), Ground water prospective zones mapping, Drought Monitoring, Flood Mapping, Snow/Glacier inventory, wet land mapping; Natural Resources Information System (NRIS), Natural Resources Census, Large Scale Mapping etc.

REFERENCES:

Introduction to Environmental Remote Sensing by Barrett E C, Curtis, I F, Chapman and Hall, New York, 1982.

Remote Sensing principles and Interpretations by Sabins, F F, (Ed) W H Freeman and Co., New York, 1986.

Remote sensing and Image interpretation by Thomas M Lillesand and Ralph W Kiefer John Wiley and Sons Inc., New York, 1994.

09 CIS - 151 CONCRETE TECHNOLOGY

Structure: Structure of aggregate phase, Structure of hydrated cement paste - Mechanism of hydration - Hydration products and micro structure - Voids in cement paste - Water in hydrated cement paste - properties of hydrated cement paste - Transition zone in concrete.

Strength: Mechanism of failure - Strength porosity relationship, Factors affecting strength, Micro cracking - relation between compressive and tensile strength - other types of strength - behaviour of concrete under various stress states - fractures mechanics - curing of concrete - testing of hardened concrete - destructive and non destructive tests.

Deformation: Stress - strain relationship - types of elastic moduli - factors affecting modulus of elasticity - determination of static elastic moduli. Shrinkages, Types, factors affecting - Mechanism of shrinkage, Creep, factors influencing - relation between creep and time, Mechanism of creep - Prediction of creep.

Durability: Permeability of concrete, chemical attack, cracking in concrete in sea water, Thermal properties - resistance to wear and other properties.

Admixtures: Classification - surface active chemicals - Superplasticizers - Set controlling chemicals - Mineral admixtures - Applications.

Mix Design: Basic considerations - fundamental aspects - mix design methods - BIS and ACI.

Special Concrete: High Performance Concrete, Light weight concrete, Fiber reinforced concrete, Polymer concrete, High density concrete - properties - materials and mix proportion - Applications.

REFERENCE BOOKS:

1. P. Kumar Mehta – Concrete – Structure, Properties and Meterials, PH, New Jersy, USA 1983.
2. A.M. Neville - "Properties of Concrete" - Longmans, 4th Edition, 1995
3. Sidney Mindess and J. Frances Young – "Concrete", PH NJ, 1981.
4. IS 10262 "Code of Practice for Concrete Mix Design".
5. IS: 10262 – Draft for Concrete Mix Design Code (Revision, 2005).

09 CEE - 22 INDUSTRIAL WASTEWATER TREATMENT

Effects of Industrial Wastes on sewages and sewage treatment plants and receiving water bodies. Effluent standards and receiving water quality standards. Different aspects and choices of various alternatives

- Ø Treating different effluent streams separately
- Ø Treating different streams jointly after mixing them partly or fully
- Ø Treating industrial Wastewater along with Municipal Wastes.

Industrial Waste survey- Process flow charts, condition of waste stream. Material balance, Sampling – Grab, Composite and integrated samples. Continuous monitoring- pH , Conductivity, Biomonitoring.

Pretreatment of Industrial Wastewater- Volume reduction, Strength reduction, Neutralization, Equalization and Proportion, Removal of Organic and inorganic dissolved solids.

Wastewater Treatment in specific industries: Distillery, Sugar, Pulp and paper, Cement, Textile, Dairy, Fertilizer, Pesticides, Pharmaceutical, Radio Active Wastes treatment – Low activity and high activity waste waters Ultimate disposal of Industrial Wastewater, effects of waste additions on physical and chemical properties of soil, Bio-Remediation Distillery, Sugar, Refinery and Diary Industries .

Design of complete treatment system disposal for industries :- Distillery, Diary, Textile , paper and pulp mill to meet P.C.B. norms .

Environmental Auditing introduction, Cost of Pollution, Environmental audit solutions, Financial and Managerial opportunities. Criminal and Regulatory liabilities.

REFERENCE BOOKS:

1. Nelson N Nemerow – Liquid Waste of industry theories, Practices and Treatment, Addison Willey New York.
2. Nardam S Azad – Industrial Wastewater Management Hand Book McGraw Hill book Co., Newyork.
3. Ross R.D. – Industrial Waste Disposal, Reinhold Environmental Series – New York.
4. Dickinson- Practical Waste Treatment and Disposal Applied Science publication, London.
5. Mahajan – Pollution control in Process industries, TMH, New Delhi.
6. Self N.J- Industrial pollution control.
7. Eckenfelder – Industrial Water pollution Control, McGraw Hill Company, New Delhi by American Chemical Society, Washington D.C. USA/
8. Gaynor W Dawson, et al – Hazardous Waste Management, A Wiley- Interscience Publication, New York.
9. James F parr et al- Land Treatment of Hazardous Wastes, Noyes Data Corporation, Parkridge, New Jersey, USA.

LIST OF JOURNALS:

- Ø ASCE Journal of Environmental Engg.
- Ø Journal of Water Research
- Ø Indian Journal of Environmental Health
- Ø Tata Energy Research Institute (Energy Environment Monitor)
- Ø Journal of Institution of Engineers (INDIA), Environmental Division.
- Ø Journal of Water Environment Research (JWPCF)

09 CEE - 253 OCCUPATIONAL SAFETY & HEALTH

Introduction: History and Development, Occupational safety and Health act. Occupational Safety and Health Administration, Right to know Laws.

Accident Causation: Need for Accident Investigation, Accident investigation plan, Methods of Acquiring Accident Facts, Correcting Missing Skills, Investigator Tendencies and Characteristics,

Supervisory Role in Accident investigation. Human Error Model, Petersew's Model, Epidemiological Models.

Ergonomics: Ergonomics at work place, Ergonomic Task Analysis, Preventing Ergonomic Hazards, Setting up of Ergonomics Programme.

Occupational Hazard and Control: Hazard Analysis, Human Error Analysis in Causation with Hazard Analysis, Fault Tree Analysis, Emergency Response. Decision for Action, Purpose and Considerations, Right Decision, Wrong Remedy, Hazard Control Measures, Hazards and their Control in Pharmaceutical, Construction, Textiles, Petroleum Refineries and LPG Bottling , Iron and Steel industries,

Fire prevention and Protection: Fire Development and its Severity effects. Enclosure, need for early Detection of Fire, Extinguishing Fire Electrical Safety Product Safety, Technical Requirements of Product Safety Programme.

Environmental Safety and ISO 14000 ISO series of standards, ISO 14001 Standards, Environmental Management systems. (EMS) Total quality Management (TQM) and Total safety Management (TSM).

Occupational Health: Health and Safety Considerations, Personal Protective Equipments, Effects of Exposure and Treatment for Metal Working Trades, Municipal Solid Waste, Epoxy Resins, Foundries. Occupational Health and Safety Considerations in Wastewater Treatment Plants.

REFERENCE BOOKS:

1. David L. Goetsch. "Occupational Safety and Health" for Technologists, Engineers and Managers 3rd edition. Prentice hall.
2. David. A. Calling - Industrial Safety Management and Technology, Prentice Hall, New Delhi.
3. Della D. E. and Giustina, Safety and Environmental Management. Van Nostrand Reinhold International Thomson Publishing Inc, 1996.
4. Trevethick R. A. Environmental and Industrial Health Hazards, William Heinemann Medical Books Ltd., London (1973).

Group IV

09 CCS - 151 COMPOSITES AND SMART – MATERIALS

Introduction to Composite materials, classifications and applications. Anisotropic elasticity - unidirectional and anisotropic laminae, thermo-mechanical properties, micro- mechanical analysis, characterization tests. Classical composite lamination theory, cross and angle–play laminates, symmetric, antisymmetric and general symmetric laminates, mechanical coupling. Analysis of simple laminated structural elements ply-stress and strain, lamina failure theories - first fly failure, vibration and buckling analysis. Sandwich structures face and core materials, secondary failure modes environmental effects, manufacturing of composites.

Introduction-smart materials and structures- piezoelectric materials – coupled electro-mechanical constitutive relations – depoling and coercive field – field-strain relation - hysterics – creep-strain rate effects – manufacturing.

Actuators and sensors – single and dual actuators – pure extension, pure bending – bending extension relations – uniform strain beam model – symmetric induced strain actuators – bond shearing force – Bernoulli-Euler (BE) beam model – embedded actuators – Asymmetric induced strain actuators in uniform strain and Euler-Bernoulli models. Uniform strain model – energy principle formulation –BE model –single and dual surface bonded actuators- Extension-bending and torsion model.

Introductions to control systems – open loop and close loop transfer functions- stability criteria – deflection control of beam like structures - using piezoelectric sensors and actuators – shape memory alloys.

REFERENCE BOOK:

Robart M Jones, “Mechanic of Composite Materials”, McGraw Hill Publishing Co.

Bhagwan D Agaraval, and Lawrence J Brutman, “Analysis and Performance of Fiber Composites”, John Willy and Sons.

Lecture notes on “Smart Structures”, by Inderjith Chopra, Department of Aerospace Engg., University of Maryland.

Crawley, E and de Luis, J., “Use of piezoelectric actuators as elements of intelligent structures”, AIAA Journal, Vol. 25 No 10, Oct 1987, PP 1373-1385.

Crawley, E and Anderson, E., “Detailed models of Piezoceramic actuation of beams”, Proc. of the 30th AIAA /ASME/ASCE/AHS/ASC- Structural dynamics and material conference, AIAA Washington DC, April 1989.

Park, C, Waltz, C and Chopra I, “Bending torsion models of beams with induced strain actuation”, 1993 North American Conference on Smart Structures and Materials, Albuquerque, New Mexico, Feb 1993.

Park C and Chopra I, “Modeling Piezoceramic actuations of beams in torsion”, 35th AIAA/ASME/ASCE/ASH/ASC Structures, Structural Dynamics and Materials conference and adaptive structures conference, Hilton Head, SC., April 1994.

09 CHY - 23 GIS AND REMOTE SENSING APPLICATIONS TO WATER RESOURCES

Remote Sensing:
Physics of Remote Sensing - Electromagnetic radiation and principle, spectral reflectance, Atmospheric windows, Satellites and sensors. Indian and other remote sensing satellites Remote sensing data products and characteristics. Introduction to microwave remote sensing techniques.

Image processing – Introduction, Remote sensing data formats, Image preprocessing and post processing, Thematic information extraction, change detection analysis.

Case studies on – assessment of ground water potential, flood control management, flood plain mapping, water logging and salt affected soil, soil moisture studies, watershed planning and management, water management in command areas, water quality modeling, hydrological modeling.

GIS:
Concepts, components, working of GIS, data capture and data integration, Data structures.
Coordinate systems and map projections, Registration.

GIS analysis and tasks – Input, manipulation, management, query and analysis, visualization, proximity analysis, overlay analysis , GIS and Remote sensing data integration.

Overview of image processing softwares and GIS softwares

Introduction to GPS and its application

TEXT BOOKS:

1. Gert A Schwtz and Edwin T Egman (2000): Remote sensing in Hydrology and water management.
2. Pavu J Gibson (2000): Introductory Remote Sensing, Principles and concepts; Routledge, London.
3. Thomas M Lillesand, Ralph W Kiefer (1994): Remote sensing and image interpretation, John Wiley and sons, N Y.

REFERENCE BOOKS:

1. Nicholas Chrismam(1997): Exploring geographical information systems, John wiley and sons, N Y.
2. Peter A. Burrough & Rachel A.McDonnel (1998): Principles of geographic information systems, Oxford University press, Great Britain.
3. John R Jensen : Introductory Digital Image processing , Prentice Hall, New Jersey.

09 CHY - 252 ENVIRONMENTAL MANAGEMENT OF WATER RESOURCES

1. **Introduction:** Sources of water – surface and ground water sources – need for Environmental Management of water sources.

2. **Ponds, Lakes and Tanks:** Inflow of sediments and nutrients – process of Eutrophication – effects of Eutrophication – preventive measures – monitoring – restoration of tanks and lakes.
3. **Streams & Rives:** Seasonal and perenmial streams – causes of quality deterioration – ill effects – impact on human society – self-purification of streams and rivers – monitoring river water quality – control measures to prevent pollution – case studies – Ganga action plan.

4. **Seas and Oceans:** Seas and Oceans as water sources – pollution due to domestic and industrial effluent discharges – oil spills – effects – need for effective management.

5. **Ground Water Sources:** Quality and quanity aspects – pollution of ground water sources – ground water depletion & seawater intrusion – Impact on human society – Management of ground water sources.

6. **Multi- purpose reservoir projects:** Impact assessment of reservoir projects – adverse effects on flora & fauna – water logging – salinity – comparison of small and big dams in terms of economy and effect on environment.

7. **Water conservation -** traditional water conservation techniques**:** Need for water conservation – scope for waste water recycling and reuse – Rain water Harvesting – Ground water recharge techniques – Farm ponds – Water audit.
8. **Environmental Economics:** A brief introduction – externalities – the problem of social cost – measuring the benefits and costs of pollution control – Pigou and Coase theories.

TEXT BOOKS:

1. Introduction to Environmental Engineering and Sciences - Gilbert M Masters, Prentice– Hall Publication
2. Environmental Engineering - Sincero and Sincero, Prentice – Hall Publication
3. Waste water Engineering - Metcelf & Eddy, Tata Mc- Graw Hill Publication

REFERENCE BOOKS:

1. Environmental Economics - Ulaganathan Sankar, Oxford University Press
2. Concepts of Ecology - Edward J Kormondy, Prentice – Hall Publication
3. Water Resources Engineering - S. K. Garg, Khanna Publishers.
4. Ground Water Hydrology - David Keith Todd

09 CIS - 21 FINITE ELEMENT ANALYSIS

Elements for 2-D and 3-D problems in FEM, Basic procedure of solving problem in FEM using Raleigh – Ritz and Galerkin formulations. Solution of 2-D problem using CST elements. Variational formulation of FE problem.

Displacement and shape functions for 2-D problems, Lagrangean, Serendipity, Hermitian Polynomials, Pascal's triangle, Convergence and compatibility requirements, Patch test, Shape function for LST, Rectangular 4–noded and 8–noded elements. QST and Sylvister triple index scheme, Static

condensation. Higher order Elements – Six nodded and nine triangular elements triangles, 8, 9 and 10 noded quadrilateral elements.
Isoparametric elements for 2-D problems, sub and super parametric elements, Convergence requirements, Shape functions for Isoparametric and Quadrilateral elements, Numerical Integration – Gauss quadrature.

Elements for solution of plate problems – Study of available elements – comparison, Mendlin's Plate Elements (Triangular, Rectangular Elements), shear loading.

Computer Program for FEM – Organisation – basic flowcharts, Packages – Pre and Post Processors. Auto mesh generation, Mesh reinforcement Vs Higher order elements, stress smoothing techniques.

REFERENCES BOOKS:

1. Zienkiewicz, O.C., "The Finite Element Method", McGraw - Hill Publishing Co. Ltd., New Delhi, 3rd Edition, 1979.
2. Desai, C.S. and Abel, J.F., "Introduction to Finite Element Method", CBS Publishers and Distributors, New Delhi, 1987.
3. Chandraputala, T.R. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice-Hall of India, Pvt.Ltd., New Delhi, 1996.
4. S. Rajashekaran –Finite Element Analysis in Engineering Design – S. Chand and Co., 2003.
5. Krishnamurthy C.S. – Finite Element Analysis – Theory and Pragrancing – II Edition, TMH 1994.
6. Cook, R.D., Malkus, D.S., and Plesha, M.E., "Concepts and Applications of Finite Element Analysis", 4th Edition Wiley, Singapore Edition, New York, 2003.
7. Logan D.L., A first course in the Finite Element Method, Thomson Asia Pvt. Ltd., Mumbai, 2004.

09 CHT - 253 ROAD SAFETY AND TRAFFIC MANAGEMENT

Road accidents, causes, scientific investigations and data collection. Analysis of individual accidents to arrive at real causes; statistical methods of analysis of accident data, application of computer analysis.

Road safety issues and various measures for road safety. Engineering, educational and enforcement measures for improving road safety. Short term and long term measures.

Road safety education and training. Innovative ideas in road safety. Economic evaluation of improvement measures by "before and after studies".

Traffic management techniques. Local area management. Transportation system management. low cost measures to be implemented immediately.

Various types of medium and long term traffic management measures and their uses. Evaluation of the effectiveness and benefits of different traffic management measures introduced. Case studies.

Control of environmental deterioration. Management of environmental pollution due to road traffic.

REFERENCES BOOKS:

1. Babkov V. F. 'Road conditions and Traffic Safety', MIR publications, - 1975.

2. K.W. Ogden, ‘Safer Roads – A Guide to Road Safety Engg.’ Aver bury Technical, Ashgate Publishing Ltd., Alder shot, England, 1996.
3. Kadiyali, L. R., ‘Traffic Engineering and Transport Planning’, Khanna Publications.
4. Pignataro, Louis, ‘Traffic Engineering - Theory and Practice’, John Wiley.
5. RRL, DSIR, ‘Research on Road Safety’, HMSO, London.
6. IRC Third Highway Safety Workshop, Lecture Notes 1978 and other IRC publications.

09 CIS - 142 NUMERICAL METHODS IN MECHANICS & ENGINEERING

Polynomial Equations in single veriable - Fixed point iterative methods - Interpolation - Various formulae and Schemes, spline interpolation Roots of Equations - Newton Raphson method, open and Bracketing methods.

Linear algebraic Equations and matrix Inversion - Gauss Elimination Iterative methods, Banded Matrix - Skyline and frontal solvers. Matrix inversions by L.U. decomposition, Approximate methods, Inversion by partipinning.

Eigen value and Eigenvectors of a matrix - Purer method, Jaoobe's method, Eiven's method, Householder's method.

Solution of ordinary differential Equations - Range-kutta methods, multi step method - Engineering applications. Curve fitting - least square's regression, Interpolation, Fourier approximation.

Finite Difference Methods. Finite difference Equations – Forward, Central and backward difference - solution of beam bending, plate bending and buckling, beams on elastic foundation problems by finite difference method.

Numerical integration - Methods - Forces and deflections in beams by numerical integration; quadrature rule.

REFERENCE BOOKS:

1. Chapra and Canale R.P - Numerical Methods for Engineers - TMH 2000 Edition.
2. Krishnamurthy E.V. and Sen S.K. Numerical Algorithms - Affiliated East-West Press - 1986.
3. Krishna Raju and K.N. Muthu Numerical Methods for Engineering problems - Macmillan Indian Ltd., - 1992.
4. Bathe and Wilson - Numerical Methods in Finite Element Analysis - PH - 1987
5. S. Rajashekharan - Numerical Methods in Science and Engineering - A practical Approach - A.J. Wheeler - 1988.

09 CIS - 153 PRE FABRICATION AND PRECAST STRUCTURES

Prefabricated construction, necessity, advantages, disadvantages, Mass produced steel, reinforced concrete and masonry systems Industrialized buildings.

Modular coordination, basic module, planning and design modules, modular grid systems, National Building Code Specifications, standardization, dimensioning of products, preferred dimensions and sizes, tolerances and deviations, layout and process.

Prefabricates classification, foundation, columns, beams, roof and floor panels, wall panels, clay units, box prefabricates, erection and assembly.

Design of prefabricated elements, Lift points beams, slabs, columns, wall panels, footings, design of joints to transfer axial forces, moments and shear forces

Construction techniques, large panel construction, lift slab system, Glover system, Constains's Jack - block system, Constain V-plate system, Bison system, Silber –Kuhi system, control of construction processes.

Equipments for horizontal and vertical transportation.

REFERENCE BOOKS:

1. Hass A.M. – Precast Concrete – Design and applications Applied Science, 1983.
2. David Shepperd – "Plant cast, Precast and Prestressed concrete – Mcgraw Hill; 1989.
3. Dyachenko and Mirtousky – Prefabrication of reinforced concrete – MIR Publishers.

09 CGT - 252 CRITICAL STATE SOIL MECHANICS

Stresses and strains in a continuum, Invariants, Octahedral stresses, theory of Plasticity- Yield function, flow rule, hardening law, failure criteria, elasto-plastic response, critical states for soil, modeling of normally and over consolidated soils, drained and undrained conditions. Grunta gravel and cam clay models.

REFERENCE BOOKS:

1. Atkinson and Brasby, "Mechanics of Soils – An Introduction to Critical state soil mechanics", ELBS 1978
2. Schofield and Worth "Critical state of soil mechanics", McGraw-Hill Pub. Co. New York, 1958

09 GIT - 12 BASICS AND FUNDAMENTALS OF REMOTE SENSING

Objectives:

- To understand the basic concepts of remote sensing, systems & techniques of data acquisition.
- To acquire skills in image processing techniques of remote sensing data.

1. **Basic Principles of Remote Sensing:**
   Concepts of remote sensing; Characteristics of electro-magnetic radiation; Interactions between matter and electro-magnetic radiation; Wavelength regions of electro-magnetic radiation; Types of remote sensing with respect to wavelength regions; Definition of radiometry; Black body radiation; Reflectance; spectral reflectance of land covers; Spectral characteristics of solar radiation; Transmittance of the atmosphere; Radiative transfer equation;

2. **Sensors:**
   Types of sensors; characteristics of optical sensors; Resolving power; Dispersing element; Spectroscopic filter; Spectrometer; Characteristics of optical detectors; Cameras for remote sensing; Film for remote sensing; Optical mechanical scanner; Pushbroom scanner; Imaging spectrometer; active and passive microwave sensors; Thermal sensors; Atmospheric sensors; Sonar; Laser radar

3. **Platforms:**
   Types of platform; Atmospheric condition and altitude; Attitude of platform; Attitude sensors; Orbital elements of satellite; Orbit of satellite; Satellite positioning systems; satellites for Land, Ocean and atmospheric studies such as Indian Remote Sensing Satellite, Landsat, SPOT, Envisat, ERS, Radarsat, IKONOS, Quickbird, etc; Geostationary / meteorological satellite; Polar orbit platform

4. **Image Interpretation and Analysis:**
   Fundamentals of satellite image interpretation; Types of imaging elements of interpretation; Techniques of visual interpretation; Generations of Thematic maps

5. **Digital Image Processing:**
   Digital data manipulation and analysis; image rectification – Radiometric correction, Atmospheric correction, Geometric correction; image enhancement – Spatial feature manipulation and multi-image manipulation; classification techniques – Supervised classification and unsupervised classification.

6. **Advanced remote sensing technologies:**
   Synthetic Aperture Radar; Side Looking Airborne Radar; Hyper spectral Imaging Spectrometer; Lidar; Thermal Imaging System; Advanced Laser Terrain Mapping

REFERENCE BOOKS:

Fundamentals of Remote Sensing: George Joseph
Remote Sensing and Image Interpretation: Lillesand & Keifer
Manual of Remote Sensing: ASP Falls Church Virginia USA
Physical aspects of Remote Sensing: P J Curran
Remote Sensing Principles and Interpretation: F F Sabins
Introduction to Remote Sensing: J B Campbell
Introductory Digital Image Processing: A Remote Sensing Perspectivs, John R Jensen

09 GIT - 243 ADVANCED DIGITAL IMAGE PROCESSING

Objective:

The course aims at introducing the various processing techniques used to enhance, interpret images and extract information from images.

1. **Digital Data:**
   Introduction-Satellite data acquisition –Storage and retrieval-Data formats-Compression-Satellite System-Data products-Image display system-Current Remote Sensing Systems

2. **Sensor and Data Models:**
   Introduction-Sensor model-Resolution, spectral and spatial response

3. **Image Rectification and Restoration:**
   Geometric Correction-Radiometric Correction -Noise Removal
4. **Image Enhancement:**
   Contrast manipulation-Gray-Level Thresholding-Level Slicing- Constract Stretching-Convolution-Edge Enhancement- Spatial feature manipulation- Fourier analysis

5. **Multi Image Manipulation:**
   Spectral Ratioing-Principal and Canonical Components-Vegetation Components-Intensity-Hue-Saturation Color Space Transformation

6. **Rectifying a Camera Image:**
   Perform Image to Image Rectification-Check Map Models-Ortho-rectification-Area correlation-Resampling-Multi-image fusion-Spatial and spectral domain fusion

7. **Information Extraction:**
   Principal-Component Images-Ratio Images-Multispectral Classification-Supervised Classification Stage-Minimum distance to means classifier, Parallelepiped classifier, Gaussian maximum likelihood classifier-Training Stage: Graphical representation of the spectral response patterns, Quantitative expressions of category separation, Self-classification of training set data, Interactive preliminary classification, Representative and subscene classification-Unsupervised Classification-Hybrid Classification- Classification of Mixed Pixels.

8. **Output Stage:**
   Graphic Products-Tabular data, Digital Information files-Post Classification Smoothing-Classification Accuracy Assessment; Classification error matrix, sampling consideration, evaluating classification error matrix.

9. **Data Merging and GIS Integration:**
   Multitemporal data merging-Change detection procedures-Multisensor image merging-Merging of Image data with Ancillary data-Incorporating GIS data in automated land Cover classification.

10. **Hyperspectral Image Analysis:**
    Atmospheric correction - Hyperspectral image analysis techniques

11. **Image Analysis and Understanding:**
    Pattern recognition-Shape analysis-Textural and contextual analysis-Decision concepts – fuzzy sets and evidential reasoning.

12. **Advanced Concepts:**
    Digital Terrain Modeling (DTM)-Stereo images-Artificial intelligence and Expert systems-Artificial Neural Network concepts

13. **Image Processing Software's:**
    ERDAS Imagine, Geomatica, ILWIS, Geomedia, eCognition, Maplnfo, GRAMS

REFERENCE BOOKS:

1. John R Jenson "Introducing Digital Image Processing" – Prentice Hall, New Jersy 1986.

2. Robert A Schowengergt, “Techniques for Image Processing and Classification in Remote Sensing”; 1983.
3. Robert A Schowengergt, “Remote Sensing – Models and Methods for Image Processing” Academic Press 1997 Hord R M, Academic Press, 1982.

09 CEE - 143 REMOTE SENSING & GIS IN ENVIRONMENTAL ENGINEERING

Definition, Remote sensing in Environmental Engineering

Basics of Remote sensing Techniques – Radiation Sources, Physics of remote sensing – Transmission Paths – Target and Sensors

Sensors – Types and Classification – Spectrial Bands of Sensors. Sensors for UV, IR and Visible ranges.

Multi spectrial scanners

Platforms – Aircrafts, Satelites,
Data Acquisition and Interpretation – Visual and digital interpretation – Brief Discussion only

Application of remote sensing techniques to management of Water resources.
Monitoring of quality of environment, land use pattern studies.

GIS – Concepts and spatial Methods – introduction spatial information, temporal information

GIS – functionality – introduction, Data acquisition, Data processing, storage and retrieval

Computer Fundamentals of GIS and data storage character files and binary files, file origination liked list, chains trees.

GIS and Remote sensing data integration techniques in spatial Decision support system, land suitability, New work analysis virtual GIS.

Hardware and software requirements for GIS.

GIS in solid waste transport, re-moduling of distribution systems and Ground water Vulnerabilty.

REFERENCE BOOKS:

1. Pater A Burraugh Rachal A Mc Donnas “Principle of GIS” (Oxford)
2. Christopher Jones “GIS and Computer Cartography”
3. Life Sand, “Remote sensing and Image interpretation, John Wiley and Sons.

09CEE - 242 HAZARDOUS WASTE MANAGEMENT

Approaches to hazardous waste reduction, properties in hazardous waste management. Development of Tracking System, Selection of the Waste Minimization Process – Case study on By – product Recovery from incineration.

Chemical, Physical and Biological Treatment:
Description of unit operation and process. Case study oil Field Waste Treatment with Mobile System.

Thermal Process: Advantages and disadvantages of incineration, Chemistry of incineration, Thermodynamics of incineration, Design of an incineration system. Incineration standards. Types of incinerators- Liquid injection, Rotory kiln and fluid bed, Multiple- Hearth furnaces, fluidized and catalytic incinerators.

Transportation of Hazardous Waste:
Regulations, Containers for Hazardous Materials. Bulk and Non-bulk Transport, Hazardous Substances Emergency Response.

Land-Fill Disposal: Landfill as disposal sites, Developing a new facility. Operating a landfill.

Site Remediation: Site Assessment and inspection, The hazardous system and the national priority list. Remedial Action, Monitoring of Disposal Sites.

REFERENCE BOOKS:

1. Wentz C.A., "Hazardous Waste Management", McGraw Hill, 1989.
2. LaGrega M.D., Mercer, "Hazardous Waste Management", 2nd Edition, McGraw Hill 2001.
3. Davis. Cornwell, "Introduction to Environmental Engineering" 3rd edition, McGraw Hill 1998.

09 CEE - 252 ENVIRONMENTAL PLANNING AND MANAGEMENT

Environmental and Sustainable Development

Concept of Carrying capacity, Relation among quality of life, carrying capacity and resource utilization.
engineering Methodology in Planning and its Limitations: Carrying capacity based short and long term regional planning

Environmental Protection: Economic development and social welfare consideration in socio economic developmental policies and planning.

Total cost of development and environmental protection cost . Case studies on Regional carrying capacity – National Capital Region – Delhi area.

Engineering Economics- Value Engineering, Time value of Money, Cash Flows. Budgeting and Accounting.

Cleaner Technologies and their roles in Environmental Protection.

Total Quality Management in Environmental Management and Protection – ISO 14000 Series of Standards.
Environmental Audit – Air, Water, Solid and its importance in Environmental Management.

REFERENCE BOOKS:

1. Danoy G. E. and Warner R. F., "Planning and Design of Engineering Systems". Unwin Hyman Publications. 1969.
2. Chanlett, "Environmental Protection" McGraw Hill Publication
3. Lohani B. N. , "Environmental Quality Management", South Asian Publications
4. Heinke et al., "A Text book of Environmental Engineering".
5. Journal of Indian Association for Environmental Management, 1995-1997.
6. MOEF. Government of India, Carrying Capacity Based Developmental Planning Studies for the National Capital Region, 1995-96.
7. NEERI, Nagpur, Annual Reports 1995 and 1996.
8. Peurifoy R. L., Construction Planning Equipment and Methods, 1979. McGraw Hill.
9. Environmental Engineering and Management, Suresh. K. Dhaneja. 2000 S. K. Kataria and Sons.

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