CE 8201 – FINITE ELEMENT APPLICATIONS IN CIVIL ENGINEERING

A. Introduction to the Finite Element Method :

General description and analysis procedure; linear constitutive equations; two-dimensional problems; constitutive relationships for plane strain, plane stress and axis symmetric cases

B. The Basic Component – Element :

Concept of the Element; element shapes; two – and three – dimensional elements; choice of elements, Element Aspect Ratio; Element stiffness; nodal degrees of freedom

C. Displacement Models :

Generalised coordinate form of displacement; Selection of Order of the Polynomial Convergence requirements; Element compatibility;

D. Displacement Models (contd.) :

Interpolation displacement model; Interpolation function or Shape function; Interpolation Functions for a one-dimensional element; Comparison of Generalised Coordinate and Interpolation formulations; Isoparametric Element Concept

E. Element Stiffness :

Direct formulation of element stiffness; force vector to be applied at nodes of element; Constant Strain Triangle Element; Element stresses and strains

F. The Overall Problem :

Discretization of the Body or Profile; Natural subdivisions at discontinuities; Bandwidth Minimization; Interconnections at Nodes; Stiffness matrix and Loads for Assemblage of Elements; Computer application of the Direct Stiffness Method

G. Civil Engineering Applications :

Constitutive laws; Elastic-plastic Behaviour; Finite representation of Infinite Bodies – significant extent of profiles for discretisation; Boundary conditions; Strip Footing Finite element mesh for embankments and cuttings; Simulation of sequential construction in Excavations (unloading) and in Embankments (loading)

Books References :

DESAI C. S. and ABEL J. F. : Introduction to the Finite Element Method
SARAN SWAMI and SINGH : Computer Programming and Numerical Methods
MOTEWAR S. N. : Computer Programming with Numerical Techniques

CE 8203 – DAM AND WATER POWER ENGINEERING

A. Reservoir Regulation :
Multipurpose reservoir operation to control floods, Supply of water for irrigation, Power combined demand, Capacity of reservoir, dead & live storage

B. Earth Dams :
Selection of site, Types of earth dams, factor of safety, Slope stability with & without seepage forces, Construction details for homogeneous and Non homogeneous sections

C. Gravity Dams :
Forces on gravity dams including earthquake Stress analysis, Overflow & Non-overflow sections, Uplift forces consideration, Drainage of dams etc.

D. Arch Dams, Buttress and Other Dams :
Constant radius & constant angle section factor of safety, Advantages, etc.

E. Surge Tanks :
Simple surge tank, restricted orifice tank and differential rank.
Surges in rectangular and non-rectangular sections, Surges for partial and complete closure of turbine.

F. Water Hammer Theory :
Rigid water column theory for concrete pipes, Elastic water column theory, Graphical and numerical methods to solve water hammer problems.

G. Economical Design of Penstocks :
Economical velocity and economical diameter, Material cost and power cost analysis to determine the diameter.

Design of hydraulic passages like Scroll cases, Draft tubes, Installation of turbines, Materials of constructions etc.

Books References :

JUSTIN, CREAGER and HINDS : Hydro-Electric Engineering Handbook
DANDEKAR M. M. and SHARMA K. N. : Water Power Engineering
PUNMIA, B. C., PANDEY and LAL B. B. : Irrigation and Water Power Engineering

CE 8205 – REMOTE SENSING APPLICATIONS IN CIVIL ENGINEERING

A. Principles of Remote Sensing :

Definitions, Electro-magnetic Remote Sensing; Data acquisition and analysis; Energy sources and Radiation sources

B. Systems of Remote Sensing :

Photographic Systems : General, Films and their sensitivity – Black and White, Colour and Infra-red; Aerial Cameras : Single lens and multi lens, Strip and Panchromatic types; Aerial Photography – Types, Scale and Resolution

C. Systems of Remote Sensing (contd.) :

Scanning Systems : Passive and Active systems; Aircraft and Satellite based Systems; Microwave Scanning Radiometers; Multi-spectral Scanners; Satellite-based Systems : Landsat, SPOT and IRS

D. Data Interpretation :

Introduction – Satellite imagery data interpretation Topographical Mapping, Stereo Parallax Measurements; Examples

E. Remote Sensing Applications :

General; Use in regional planning and development

F. Remote Sensing Applications in Civil Engineering :

Urban Development and Highway Engineering Projects

G. Remote Sensing Applications in Civil Engineering (contd.) :

Water Resources and Environmental Engineering

References :

WOLF : Elements of Photogrammetry
SABINS FLOYD F. Jr. : Principles and Image Interpretation
LILLESAND and KEIFER : Remote Sensing and Image Interpretation
KENNIE T. J. M. : Remote Sensing in Civil Engineering

CE 8207 – DISASTER MANAGEMENT

A. Introduction:

Types of Disasters, Natural Hazards and Disasters

B. Disaster Risk Reduction and Phases of Disaster Management:

Mitigation, Preparedness, Response, Recovery, Rehabilitation, Community Capacity Building, Disaster Risk Reduction by Education, Information and Public Awareness, Role of Government in Disaster management

C. Earthquake:

Structure of Earth, Plate Tectonics, Causes of Earthquake, Epicentre, Hypocentre, Magnitude and Intensity, Isoseismals, Different types of earthquake waves, Seismic Zoning of India. Structural form and earthquake resistance, Plan and Shape of Buildings, Soft stories, Slenderness limitations, Strong Column-Weak Beam, Slenderness Limitations, Base isolation – different techniques, Soil response to earthquake, Site Selection, Liquefaction . Retrofitting of structures,
Use of IS Codes

D. Tsunami and Cyclone:

Tsunami: The process of triggering waves, Dynamics of Tsunami waves, Management of Tsunami disaster
Cyclone: Major location of occurrence, Intensity classification, Cyclone Resistant Design, Management and mitigation

E. Flood and Drought:

Flood: Types of Flood, Effects of Flood, Flood Defences and Management.
Drought: Concept of Drought, Consequences of Drought, Drought profile, Management and Risk Reduction, Lessons on Mitigation

F. Landslide:

Causes, Signs and early warning system of Landslides, Means of Mitigation

G. Fire:

Terminologies - Fire Resistance, Fire Endurance, Fire detection and alarm, Property of different materials at elevated temperatures, Mitigation measures

References :

CHAKRABORTY S. C. : Natural Hazards and Disaster Management
SHARMA NEELAM : Earthquake Resistant Building Construction
SAHNI P. and ARIYABANDU M. : Disaster Reduction Risk in South Asia
JAIN V. K. : Fire Safety in Building

CE 8219 – EARTHQUAKE RESISTANCE DESIGN OF STRUCTURES

A. Ground Motion during Earthquakes :

Seismology, Seismic Zoning Map, Characteristics and Study of Strong Motion; Types of Waves : P-, R- and S-waves; Epicenter, Hypocenter, Locating Epicenter; Terminologies - magnitude, intensity and measurement, Record of notable earthquakes

B. Dynamics of Structures :

Introduction; Single dof systems, Seismic Pickups, Dynamic Response and Response Spectra

C. Earthquake Resistance consideration for R C Buildings :

Concepts; Effect of Vibration on Structures; Basics of Earthquake Resistant Design; Architectural consideration in Design of Buildings to resist earthquakes

D. Seismic Analysis and Modeling of R C Building :

Design Lateral Load – determination on Code Procedure; Infill wall consideration in Seismic Analysis; Mathematical modeling and Stepwise Procedure for Analysis

E. Earthquake Resistant Design of R C Buildings :

Ductility consideration in Earthquake Resistant Design; Typical Designs of Building and Shear Wall; Capacity Based Design

F. Earthquake Resistant Design of Masonry Buildings :

Identification of Damages to and Survival from Earthquakes Masonry Buildings in Past; Elastic Properties of Structural Masonry; Lateral Load Analysis of Masonry Buildings

G. Seismic Evaluation and Retrofitting of Buildings :

Practical Approach towards Seismic Evaluation of R C Buildings; Provisions for Improving Performance of non-engineered Masonry Construction; Retrofitting Strategies of R C and Masonry Buildings

References :

AGARWAL PANKAJ and SHRIKHANDE MANISH : Earthquake Resistant Design of Structures, Prentice-Hall (2006)

COBURN ANDREW and SPENCER ROBIN : Earthquake Protection, John Wiley

CHOPRA A. K. : Dynamics of Structures – Theory and Applications to Earthquake Engineering, Prentice Hall

.

IS : 1893 - 2002, Indian Standard Criteria for Earthquake Resistant Design of Structures : Part I – General Provisions and Buildings

IS : 13920-1993, Indian Standards Guide to Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces

CE 8229 – PAVEMENT DESIGN

A. Introduction:
Types of Pavements, Flexible and Rigid, Unconventional Pavements, Pavement composition and functions of different layers, Relevant IRC codes, guidelines and publications for Roads & Highways

B. Foundation and Subgrade:
Desirable properties of Subgrade, Soil Classification, Evaluation of soil Strength, CBR value, Resilient Modulus, Modulus of Sugrade reaction, In-situ methods of subgrade characterisation, Soil Stabilisation

C. Pavement Materials:
Bitumen, Tar, Emulsion, Modified Bitumen, Cement Concrete, Aggregates, Flyash, Tests on Materials, Material Characterisation, Bituminous Mix Design : Marshall and SuperPave methods

D. Traffic:
Axle Load, Equivalent single Wheel Load, Contact Pressure, Vehicle Damage Factor, Load Repetitions, Design Traffic

E. Flexible Pavements:
Elastic Layered Analysis of Flexible Pavements, Stresses and Strains at critical locations, Various methods of Flexible pavement design, IRC and AASHTO methods of Flexible Pavement Design, Drainage consideration

F. Rigid pavements
Different Types of Rigid Pavement construction: PCC, JRCP, CRCP; Westergaard's Analysis for stresses in concrete pavements, Thermal Stresses, Joints in Concrete pavements, IRC and AASHTO methods of Rigid Pavement Design

G. Pavement Evaluation and Overlay design:
Structural Evaluation of Pavements, Benkelman Beam, Falling Weight Deflectometer (FWD), Dynamic Cone Penetrometer (DCP), Overlay Design of pavements as per IRC and AASHTO guidelines

Reference Books:

HUANG Y. H. : Pavement Analysis and Design
YODER E. J. and WITCZAK M. W. : Principles of Pavement Design
ULLITZ PER : Pavement Analysis
CRONEY D. and CRONEY P. : Design and Performance of Road Pavements