

CEU321 STATISTICS, PROBABILITY AND RELIABILITY

METHODS IN ENGINEERING

L	T	P	Cr
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Module I (8hours)

Role of Probability in Engineering. Data Deduction. Basic Probability Concepts — Sample space and events, probability measure, mathematics of probability, theorem of Total Probability, Bayes' Theorem.

Module II (10hours)

Random variables — Probability distribution of a random variable, multiple random variables, main descriptors of a random variable – Moments, expectation, covariance, correlation, conditional mean and variance.

Functions of Random variables — Expectation of a function of a random variable, derived probability distributions, approximate moments and distributions of functions.

Module III (12hours)

Common Probabilistic Models — Models from Simple Discrete Random trails, Models from Random occurrences, Models from limiting cases, other commonly used Distributions, Multivariate Models.

Estimating Parameters from observed Data — Classical Approach to Estimation of Parameters.

Empirical Determination of Distribution Models - Probability paper, testing validity of Assumed Distribution. Regression and Correlation Analyses.

Module IV (12hours)

Reliability and Reliability Based Design — Reliability of engineered system, Analysis and Assessment of Reliability, Monte Carlo Method, Second Moment Formulation, Probability Based Design Criteria.

Introduction to Reliability of Structural Systems — System Reliability, Series Systems, Parallel Systems, Mixed systems.

References

1. Ang, A. H. S & Tang, W. H., Probability Concepts in Engineering Planning and Design Vol. I Basic Principles, John Wiley & Sons.
2. Ang, A. H. S & Tang, W. H., Probability Concepts in Engineering Planning and Design Vol. II Decision, Risks and Reliability, John Wiley & Sons.
3. Jack R. Benjamin & C. Allin Cornell., Probability, Statistics and Decision for Engineers, McGraw-Hill.
4. Papoulis, A., Probability, Random Variables and Stochastic Processes, McGraw Hill.
5. R. Ranganathan., Reliability Analysis and Design of Structures, Tata McGraw Hill, 1990
6. H. O. Madsen, S. Krenk & N. C. Lind, Methods of Structural Safety, Prentice-Hall, 1986.
7. R. E. Melchers. Structural Reliability - Analysis and prediction, Ellis Horwood Ltd

CEU322 CONCRETE TECHNOLOGY

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Materials: cement - different types - chemical composition and physical properties - tests on cement - I.S. specifications - aggregates - classification - mechanical properties and tests as per I.S. - alkali aggregate reaction - grading requirements - heavy weight - light weight - normal weight - aggregate - sampling of aggregate - water - quality of water - permissible impurities as per I.S - admixtures - accelerators - retarders - water reducing agents – super plasticizers- use of silica fumes

Module II (11 hours)

Manufacture of concrete - measurement of materials - storage and handling - batching plant and equipment - mixing - types of mixers - transportation of concrete - pumping of concrete - placing of concrete - under water concreting - compaction of concrete - curing of concrete - ready mixed concrete - mix design - nominal mixes - design mixes - factors influencing mix design - A.C.I method - I.S method - design for high strength mixes

Module III (11 hours)

Properties of concrete - fresh concrete - workability - factors affecting workability - tests for workability - segregation and bleeding - hardened concrete - factors affecting strength of concrete - strength of concrete in compression, tension and flexure - stress- strain characteristics and elastic properties - shrinkage and creep - durability of concrete - permeability - chemical attack - sulphate attack - resistance to abrasion and cavitation - resistance to freezing and thawing - resistance to fire - marine atmosphere - quality control - frequency of sampling - test specimens - statistical analysis of test results - standard deviation - acceptance criteria

Module IV (10 hours)

Special concrete - light weight concrete - high density concrete - vacuum concrete - shotcrete - Fibre reinforced concrete-polymer concrete - ferrocement - high performance concrete - self compacting concrete - types of failure - diagnosis of distress in concrete - crack control - leak proofing - guniting and jacketing techniques.

References

1. Neville A.M., Properties of Concrete, Pitman
2. Shetty M.S., Concrete Technology, S I Chand & Company, 1993.
3. Gambhir M.L., Concrete Technology, Tata McGraw Hill, 1995.
4. Orchard D.F., Concrete Technology Vol. I & II, 1968.
5. Krishna Raju N., Design of Concrete Mixes, CBS publishers, 1988.
6. Raina V.K., Concrete for Construction-Facts & Practices, Tata McGraw Hill publishing co. 1988.
7. John.H.Bungey, The Testing of Concrete in Structures, Urey University of Press Hall
8. Akroyd T.N.W., Concrete: Properties & Manufacture, Pergamon Press, 1962.
9. Murdock L.J., Concrete: Materials & Practice, Edward Arnold, 1968.

CEU323 GROUND IMPROVEMENT

L	T	P	Cr
3	0	0	3

Module I (11 hours)

Introduction to soil improvements without the addition of many material - dynamic compaction - equipment used - application to granular soils - cohesive soils - depth of improvement - environmental considerations - induced settlements - compaction using vibratory probes - vibro techniques vibro equipment - the vibro compaction and replacement process - control of verification of vibro techniques - vibro systems and liquefaction - soil improvement by thermal treatment - preloading techniques - surface compaction introduction to bio technical stabilization

Module II (11 hours)

Introduction to soil improvement by adding materials - lime stabilization - lime column method - stabilization of soft clay or silt with lime - bearing capacity of lime treated soils - settlement of lime treated soils - improvement in slope stability - control methods - chemical grouting - commonly used chemicals - grouting systems - grouting operations - applications - compaction grouting - introduction - application and limitations - plant for preparing grouting materials - jet grouting - jet grouting process - geometry and properties of treated soils - applications - slab jacking - gravel - sand - stone columns

Module III (10 hours)

Soil improvement using reinforcing elements - introduction to reinforced earth - load transfer mechanism and strength development - soil types and reinforced earth - anchored earth nailing reticulated micro piles - soil dowels - soil anchors - reinforced earth retaining walls

Module IV (10 hours)

Geotextiles - polymer type geotextiles - woven geotextiles - non woven geotextiles - geo grids - physical and strength properties - behaviour of soils on reinforcing with geotextiles - effect on strength, bearing capacity, compaction and permeability - design aspects - slopes - clay embankments - retaining walls - pavements

References

1. Moseley, Text Book on Ground Improvement, Blackie Academic Professional, Chapman & Hall, 1994.
2. Boweven R., Text Book on Grouting in Engineering Practice, Applied Science Publishers Ltd
3. Jewell R.A., Text Book on Soil Reinforcement with Geotextiles, CIRIA Special Publication, Thomas Telford
4. Van Impe W.E., Text Book On Soil Improvement Technique & Their Evolution, Balkema Publishers
5. Donald .H. Gray & Robbin B. Sotir, Text Book On Bio Technical & Soil Engineering Slope Stabilization, John Wiley
6. Rao G.V. & Rao G.V.S., Text Book On Engineering With Geotextiles, Tata McGraw Hill
7. Korener, Construction & Geotechnical Methods In Foundation Engineering, McGraw Hill

CEU324 REINFORCED EARTH AND GEOTEXTILES

L	T	P	Cr
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Module I (10 hours)

Reinforced Earth – The mechanisms of the reinforced earth techniques –
Design principles – Materials used for construction – Advantages of reinforced earth –
Reinforced earth construction techniques

Module II (11 hours)

An overview of Geosynthetics, Description of Geotextiles – Geogrids – Geonets –
Geomembranes – Geocomposites – Geocells – Designing with Geotextiles – Geotextile
properties and test methods – Functions of Geotextile – Design methods for separation –
stabilization – filtration – Drainage

Module III (11 hours)

Designing with Geogrids – Geogrid properties and test methods – Designing with Geonets –
Geonet properties and test methods – Designing with Geomembranes – Geomembrane
properties and test methods – construction practices with Geotextiles, Geogrids, Geonets,
Geomembranes

Module IV (10 hours)

Design of liquid Contaminant liners – liquid contaminant liners – Covers for reservoirs-
Water conveyance (Canal liners)-- solid material liners – underground storage tanks – Design
of pavements – Geo composites as liquid / Vapour Barriers –Improvement in bearing capacity
– Erosion Control for water ways.

References

1. Robert M. Koerner, Designing with Geosynthetics, Prentice Hall ,1989 .
2. G.V Rao & GVS Suryanarayana Raju, Engineering with Geosynthetics, Tata Mc Graw Hill Publishing Co. New Delhi.

CEU325 WATER CONVEYANCE SYSTEMS

L	T	P	Cr
3	0	0	3

Prerequisite CEU212 Hydro Systems

Module I (10 hours)

Elements of Open Channel Flow – Design Principles of Lined and Unlined Canals- Canal Network and Hierarchy of Canals Afflux & Energy Loss.

Module II (10 hours)

Main Canal & Flow Distribution Control, Decentralised Control, Canal Automation: Purpose and Selection Of Scheme Automation Application- Hardware and Software Components in a Automation Systems- A Typical Automation System Explanation.

Module III (10 hours)

Elements of Pipe Flow - Losses in Pipe Flow- Pumping & Gravity Mains- Choice of Pipe – Pipe Materials- Design Principles

Module IV (12 hours)

Flow Transients- Surges And Water Hammer – Causes, Problems and Protection. Pipe Joints- Valves Distribution Network Analysis and Design

References

1. Chow V. T., Open Channel Hydraulics, Mc Graw Hill 1959
2. Canal automation CBIP Publication 1993
3. Pipeline Industries Guild, Pipeline Design. Construction & Operation, Construction Press, London 1984
4. Hanif Choudhary, Open Channel Flow, Prentice Hall of India, New Delhi 1994
5. Thomas Walski, Walter M. Grayman, Water distribution Modeling, Haested Press, 2001.

CEU326 HYDRAULIC MACHINES

L	T	P	Cr
3	0	0	3

Prerequisite CEU212 Hydro Systems

Module I (10 hours)

Introduction:-Classification of Hydraulic Machines- Dynamic Thrust of a Jet on Fixed and Moving Surfaces- Work Done and Efficiency

Module II (10 hours)

Turbines : introduction – classification- head, power and efficiencies
Pelton wheel - Work done & Efficiency – Working proportions - Multiple jet pelton wheel - Design.

Francis turbine- general description- Work done & Efficiency - Working proportions – Design- Draft tubes- Draft tube theory- Types of draft tubes

Kaplan turbine; General description- Working proportions - Design - Governing of turbines - performance Characteristics- Selection of turbines. Runaway speed – Surge tanks

Module III (12 hours)

Pumps – Introduction- reciprocating pumps- Work done – Single acting & Double acting type- Indicator diagram- Theoretical and modified for effect of acceleration and friction in pumps. Air vessels– Multi cylinder Pumps- Centrifugal pumps – Introduction – Comparison with Displacement type pump- Work done- Head and Efficiency- Net positive suction head – Specific speed – Model Testing- Cavitation – Performance characteristics – Multistage pumps- Selection- Installation – Operation and maintenance - Trouble shooting in Centrifugal pumps.

Modules IV (10hours)

Others types of pumps in common use – General description- Characteristics – Design- Selection- Installation – Troubles and remedies in case of Deep well turbine and submersible pumps- propeller- mixed flow and jet pumps.

References

1. A. M. Michael , S. D. Khepar, Water well and Pump engineering, Tata Mc - Graw Hill public. Company New Delhi
2. P.N. Modi & S.M. Seth, Fluid Mechanics & Hydraulic Machines, Standard Book House, New Delhi
3. Jagdish Lal, Fluid Mechanics & Hydraulic Machines, Standard Book House, New Delhi

CEU327 HIGHWAY & AIRPORT PAVEMENT DESIGN

Prerequisite CEU215 Transportation Engineering I

L	T	P	Cr
3	0	0	3

MODULE I (6 hours)

Introduction: Types and Component parts of Pavements, Factors affecting Design and Performance of Pavements, Comparison between Highway and Airport pavements. Functions and Significance of Subgrade properties, Various Methods of Assessment of Subgrade Soil Strength for Pavement Design. Causes and Effects of variation in Moisture Content and Temperature, Depth of Frost Penetration.

MODULE II (9 hours)

Stresses in Flexible Pavements: Stresses and Deflections in Homogeneous Masses, Burmister's 2- layer, 3- layer Theories, Wheel Load Stresses, ESWL of Multiple Wheels, Repeated Loads and EWL factors, Sustained Loads and Pavement behaviour under Traffic Loads.

MODULE III (9 hours)

Methods of Flexible Pavement Design: Empirical, Semi-empirical and Theoretical Approaches; Development, Principle, Design steps, Advantages and Applications of different Pavement Design Methods.

MODULE IV (9 hours)

Stresses in Rigid pavements: Types of Stresses and Causes, Factors influencing the Stresses; General conditions in Rigid Pavement Analysis, ESWL, Wheel Load Stresses, Warping Stresses, Friction Stresses, Combined Stresses.

MODULE V (9 hours)

Methods of Rigid Pavement Design: Types of Joints in Cement Concrete Pavements and their Functions, Joint Spacings, Design of Slab Thickness, Design of Joint Details for Longitudinal Joints, Contraction Joints and Expansion Joints, IRC Method of Design.

References

1. Yoder and Witezak, Principles of Pavement Design, John Wiley and sons, Second Edition, 1975.
2. Yang, Design of functional pavements, McGraw-Hill.
3. RRL, DSIR, Concrete Roads, HMSO Publications.
4. IRC: 37 - 2001, 'Guidelines for the Design of Flexible Pavements'
5. IRC: 58 - 2002, 'Guidelines for the Design of Rigid Pavements'

CEU328 ADVANCED MECHANICS OF MATERIALS

Prerequisite CEU 201 Mechanics of Solids

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Theories of stress and strain: definition of stress at a point - stress notation - symmetry of the stress array and stress on an arbitrarily oriented plane - transformation of stress - principal stresses - other properties - differential equation of motion of a deformable body - deformation of a deformable body - strain theory - principal strains - strain of a volume element - small displacement theory

Stress-strain relations: elastic and inelastic response of a solid - first law of thermodynamics - internal energy density - complementary internal-energy density - Hooke's law - anisotropic elasticity - Hooke's law - isotropic elasticity - plane stress and plane strain problems

Module II (8 hours)

Torsion: torsion of a cylindrical bar of circular cross section - Saint-Venant's semi-inverse method - linear elastic solution - the Prandtl elastic membrane (soap-film) analogy - narrow rectangular cross section - thin-wall torsion - members with restrained ends - fully plastic torsion

Module III (12 hours)

Nonsymmetrical bending of straight beams: definition of shear centre in bending - symmetrical and nonsymmetrical bending - bending stresses in beams subjected to nonsymmetrical bending - deflections of straight beams subjected to unsymmetrical bending - changing in direction of neutral axis and increase in stress and deflection in rolled sections due to a very small inclination of plane of loads to a principal plane - fully plastic load for unsymmetrical bending

Curved beams: introduction - circumferential stress in a curved beam - radial stresses in curved beams - correction of 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 - fully plastic loads for curved beams.

Module IV (12 hours)

Beams on elastic foundation: 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

Failure criteria: modes of failure - failure criteria - excessive deflections - yield initiation - extensive yield - fracture - progressive fracture (high cycle fatigue for number of cycles $N > 10^6$), buckling.

References

1. Boresi, A.P. and Sidebottom, O.M., Advanced Mechanics of Materials, John Wiley & Sons.
2. Srinath, L.S., Advanced Mechanics of Materials, Tata McGraw Hill, 1988.
3. Timoshenko, S., Strength of Materials, Part II, CBS Publishers.
4. Timoshenko, S.P. and Goodier, J.N., Theory of Elasticity, McGraw Hill.

CEU 329 Finite Element Analysis of Fluid Flow

Prerequisite CEU 203 / MEU 201 Mechanics of Fluids

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Review of Basic Equations of Fluid Mechanics, and Pipe Network Analysis:

Continuity, momentum, and energy equations, nonviscous fluid flow, irrotational flow, velocity potential, stream function, Bernoulli's equation, Navier-Stokes equation. Linear finite element analysis of pipe network, total system of equations, boundary conditions, solution of system of equations, nonlinear analysis of pipe network, computer algorithms for linear and nonlinear analyses.

Module II (12 hours)

One Dimensional Flow Analysis:

Interpolation functions, C^m -continuity. Governing differential equations, finite element formulations, and solutions for (i) laminar flow through pipes (ii) viscous flow on an inclined flat surface (iii) thin-film lubrication (iv) radial flow in an unconfined aquifer.

Isoparametric formulation. Numerical integration. Transformation of velocity, stress rates, and stiffness matrix.

Module III (10 hours)

Potential Flow Analysis:

Euler's equation of motion, stream function formulation, potential function formulation, finite element solution for groundwater flow and flow around a cylinder. Finite element solution of Navier-Stokes equations using stream function and vorticity formulation.

Module IV (10 hours)

Time-dependent field problems:

One dimensional diffusion equation, analytical integration technique, time domain integration techniques – Euler method and Improved Euler method. Introduction to typical CFD packages like FLUENT.

References:

1. C. A. Brebbia, and A. J. Ferrante. *Computational Hydraulics*, Butterworths & Co (Publishers) Ltd., 1983.
2. T. J. Chung. *Computational Fluid Dynamics*, Cambridge University Press, 2003
3. C. B. Vreugdentil. *Computational Hydraulics*, Springer-Verlag, 1989.
4. W. B. Bickford. *A First Course in the Finite Element Method*, Irwin, 1994.
5. L. T. Segerlind. *Applied Finite Element Analysis*, John Wiley and Sons, 1984.
6. J. N. Reddy. *An Introduction to the Finite Element Method*, McGraw-Hill Book Company, 1993.
7. O. C. Zienkiewicz, and R. L. Taylor. *The Finite Element Method – Vols. I and II*, McGraw-Hill Book Company, 1989.
8. S. S. Rao. *The Finite Element Method in Engineering*, Elsevier, 2004.
9. O. C. Zienkiewicz, and K. Morgan. *Finite Elements and Approximation*, John Wiley and Sons, 1983.
10. O. C. Zienkiewicz, R. L. Taylor, and J. Z. Zhu. *The Finite Element Method – Its Basics and Fundamentals*, Elsevier, 2005.
11. A. J. Baker. *Finite Element Computational Fluid Mechanics*, McGraw-Hill Book Company, 1983.
12. J. N. Reddy, and D. K. Gartling. *Finite Element Method in Heat Transfer and Fluid Mechanics*, CRC Press, 2001

CEU351 PRE STRESSED CONCRETE

L	T	P	Cr
3	0	0	3

Prerequisite To have registered for CEU312 Structural Concrete Design

Module I (9 hours)

Materials for prestressed concrete and prestressing systems

High strength concrete and high tensile steel – tensioning devices – pretensioning systems – post tensioning systems.

Module II (11 hours)

Analysis of prestress and bending stresses

Analysis of prestress – resultant stresses at a sector – pressure line or thrust line and internal resisting couple – concept of load balancing – losses of prestress – deflection of beams.

Module III (9 hours)

Strength of prestressed concrete sections in flexure, shear and torsion

Types of flexural failure – strain compatibility method – IS code procedure – design for limit state of shear and torsion.

Module IV (13 hours)

Design of prestressed concrete beams and slabs

Transfer of prestress in pre tensioned and post tensioned members – design of anchorage zone reinforcement – design of simple beams – cable profiles – design of slabs.

A design project for the design and detailing of a large span beam is envisaged at this stage.

References

1. N. Krishna Raju, Prestressed concrete, Tata McGraw Hill, 2000
2. T.Y. Lin, Ned H. Burns, Design of Prestressed Concrete Structures, John Wiley & Sons, 2004.
3. P. Dayaratnam, Prestressed Concrete, Oxford & IBH, 1982
4. R. Rajagopalan, Prestressed Concrete, Narosa publishers, 2004.
5. BIS codes (IS 1343)

CEU352 EARTH AND EARTH RETAINING STRUCTURES

Prerequisite CEU303 Geotechnical Engineering I

L	T	P	Cr
3	0	0	3

Module I (11 hours)

Introduction

Earth dams – types of dams – selection of type of dam based on material availability – foundation conditions and topography

Design details – crest, free board, upstream and down stream slopes, upstream and down stream slope protection – central and inclined cores – types and design of filters

Seepage analysis and control – seepage through dam and foundations – control of seepage in earth dam and foundation

Module II (11 hours)

Stability analysis – critical stability conditions – evaluation of stability by Bishop's and sliding wedge methods under critical conditions

Construction techniques – methods of construction – quality control

Instrumentation – measurement of pore pressures

Earth pressure theories – Rankine's and Coulomb's earth pressure theories for cohesionless and cohesive backfills – computation of earth pressures for various cases – inclined – with surcharge – submerged and partly submerged – stratified backfills

Module III (10 hours)

Rigid retaining structures – active and passive earth pressures against gravity retaining walls – Surcharge - computation of earth pressures by Trial wedge method – a mathematical approach for completely submerged and partly submerged backfills – importance of capillarity tension in earth pressure.

Graphical methods of earth pressure computation – trial wedge method for coulomb's and Rankine's conditions, for regular and irregular ground and wall conditions – Rebhan's construction for active pressure – friction circle method – logarithmic spiral method.

Design of gravity retaining wall – cantilever retaining walls

Module IV (10 hours)

Flexible retaining structure – type and methods of construction – design strength parameters – safety factor for sheet pile walls – computation of earth pressures against cantilever sheet piles in cohesionless and cohesive soils – anchored sheet piles – free earth method – fixed earth method – Rowe's moment reduction method – stability of sheet piling

Diaphragm walls and coffer dams – type of diaphragm walls and their construction techniques in various soil types – earth pressure on braced cuts and coffer dams – design of coffer dams

References

1. Huntington, Earth pressure on retaining walls, John Wiley & Sons, 1957.
2. Bowles, Foundation Analysis and Design, 1968.
3. Jones, Earth Reinforcements & Soil structures.
4. Prakash, Ranjan & Sasan, Analysis & Design of Foundation & Retaining structures.

CEU 353 ENVIRONMENTAL GEOTECHNICS

L	T	P	Cr
3	0	0	3

Module I (11 hours)

Introduction to environmental geotechnology –Regulatory requirements

Basic soil mineralogy: structural units of soil - Clay mineral structures - Identification and determination of clay minerals - Particle bonds, bond energies and linkages, Ion exchange reaction and capacity- Hydrophilic and hydrophobic soils.

Soil water interaction: Introduction – Electrochemical characteristics of soil water system - Soil water interaction in the thermal energy field – Geomorphic process in soil – effect of bacteria on behaviour of soil water system –Sensitivity of soil to environment.

Introduction to Hydrogeology – Hydraulic conductivity – Infiltration, percolation, retention and recharge – Flow in unsaturated soils – Flow in saturated soils

Geo chemistry – Geochemical attenuation

Ground water monitoring techniques.

Module II (12 hours)

Sources and types wastes - Waste characteristics - Objectives of waste disposal facilities

Contaminant transport – Transport process: diffusion, dispersion, advection – Dispersion: analytical solutions

Landfills and surface impoundments: – Types, components and requirements of landfills - siting of land fills – Various end uses of closed landfills - Landfill microbiology – Microbiology of refuse composition- Leachate and gas generation - Primary and Secondary leachate - Leachate collection and removal systems -Gas collection and removal systems – Impact of hazardous waste on leachate and gas characteristics

Module III (9 hours)

Liners – Natural clay liners – compacted clay liners – requirements of clay liners – Geo synthetic clay liners – Geomembrane liners - Specifications of liners in hazardous wastes land fills – Quality control of liners.

Design of Cover systems – Recovery well design

Module IV (10 hours)

Geophysical techniques for site characterization – Sampling – Testing of samples - Slope stability analysis of land fills – Water balance for land fills

Soil remediation technologies: Soil washing – Electrokinetic remediation - Soil vapor Extraction - Soil Vapor Extraction – Bioremediation - Stabilization and Solidification.

Groundwater remediation technologies: Pump and Treat - In-Situ Flushing - Bioremediation.

Mine waste disposal systems.

Reference books

1. David.E.Daniel, *Geotechnical practice for waste disposal* – Chapman & Hall – London.
2. Masashi Kamon, editor – Balkema, *Environmental Geotechnics*, - Rotterdam 1996
3. Hsai- Yang Fang, *Introduction to Environmental Geotechnology*, - CRC Press, New York

CEU354 COMPUTER APPLICATIONS IN HYDROENGINEERING

Prerequisite CEU212 Hydro Systems

L	T	P	Cr
3	0	0	3

Module I (12 hours)

Review of Basic Hydraulic Principles – General flow characteristics, Energy and momentum principles and Equations, Pressure and free surface flows, HGL and TEL, Major and minor losses, Computer applications to simple flow problems, Introduction to SAP.

Storm Sewer Design and Gravity Piping Systems – Review of basic hydrologic principles, Gradually varied flow, Mixed flow profiles, Storm Sewer Applications.

Module II (12 hours)

Drainage Inlet Design, Culvert Hydraulics and Design.

Pressure Piping Systems & Water Quality Analysis – Analysis and design of water distribution systems

Introduction to Some Packages such as Flow Master, Storm CAD, Culvert Master, Water CAD, and Sewer CAD and EPANET.

Module III (10 hours)

Flow Routing - Hydrologic and hydraulic methods of routing, Sanitary sewer design including extended period simulation and routing.

Watershed modeling – Basic principles – Introduction to SWMM

Module IV (8 hours)

Water quality modeling in streams- Basic models, Introduction to software packages.

Ground water quality modeling

Introduction to remote sensing and GIS applications and web based applications

References

1. Michael. M. Meadows & Thomas M Walski, Computer Applications in Hydraulic Engineering, Haestad Press, 2001.
2. QIP Short Term Course Notes, Advanced IT Applications in Civil Engineering: IIT, Kharagpur, 2001.
3. L.W. Mays, Water Resources Engineering, John Wiley and Sons, 2001.
4. S.C.Chapra, Surface Water Quality Modeling, McGraw Hill, Inc., 1997.

CEU355 REMOTE SENSING AND GIS APPLICATION

L	T	P	Cr
3	0	0	3

Module I (12 hours)

Concepts and foundations of remote sensing- electromagnetic spectrum, energy sources and radiation principles, energy interactions in the atmosphere and with earth surface features, data acquisition and interpretation, reference data, ideal remote sensing systems, characteristics of real remote sensing systems. Classification of maps, map scale, spatial reference system, map projections, grid systems, linkage of GIS to remote sensing. Radar principle- Factors affecting microwave measurements, radar wavebands, SLAR systems, interaction between microwaves and earth's surface. Elements of photographic systems - film exposure, film density and characteristic curves, spectral sensitivity of black and white films, colour film and colour infrared film, filters, aerial cameras, film resolution, electronic and multi band imaging, aerial videography. Basic principles of photogrammetry – geometrical characteristics of aerial photographs, photographic scale, ground coverage, area measurement, relief displacement of vertical features, image parallax, ground control, mapping.

Module II (11 hours)

Remote sensing platforms and sensors - Satellite system parameters, sensor parameters, imaging sensor systems, earth resources and meteorological satellites with microwave sensors, scanners, radiometers. The Indian Remote Sensing Program. Data types and format, scale and legend.

Visual Image Interpretation - types of pictorial data products, fundamentals of visual image interpretation, equipment, image interpretation strategy, process of image interpretation, key elements of visual image interpretation, false colour composites, application in natural resources management. Digital Image Processing - Basic character of a digital image, image rectification & restoration, preprocessing, registration, enhancement, contrast, spatial feature and multi image manipulation, spatial filtering, image transformations, image classification, performance analysis, data merging and GIS integration.

Module III (11 hours)

GIS overview – what is GIS, components, definitions & terminology, uses, GIS queries & architecture, theoretical models & framework, GIS technology trends, data sources, collection, and entry, data formats & standards, types of analysis, spatial data modeling, GIS data management, database models, storage of data, object based GIS models, data input & editing, data quality issues. Data analysis & modeling – Integration of remote sensing & GIS.

Module IV (8 hours)

Application of Remote Sensing & GIS in natural resources management with specific reference to impact of mining activities on environment, biodiversity, coastal zone protection, flood management, forest protection, monitoring urban growth, managing watersheds & water resources, hydrologic modeling, preventing natural disasters etc.

References

1. Thomas. M. Lillesand and Ralph. W. Kiefer, Remote Sensing and Image Interpretation :, John Wiley and Sons, Inc., 2002
2. M. Anji Reddy, Text Book of Remote Sensing and Geographical Information Systems:, B.S. Publications, 2001
3. Ian Heywood, Sarah Cornelius, and Steve Carver, An Introduction to Geographical Information Systems, Pearson Education Asia, 2001
4. George. B. Korte, The GIS Book:, Onward Press, Thomson Learning, 2001
5. D. P. Rao, Association of Exploration Geophysicists, 1995, Remote Sensing for Earth Resources.
6. L.R.A. Narayan, Remote Sensing and its Application, Universities Press, 1999.
7. P.A. Borrough, Rachel A. MsDonnel., Principles of Geographic Information System. Oxford University Press, 1998.
8. E.T. Engman ., R.J. Gurney, Remote Sensing in Hydrology, Chapman & hall, 1991.

CEU356 ENVIRONMENTAL HYDRAULICS

L	T	P	Cr
3	0	0	3

Prerequisite CEU212 Hydro Systems

Module I (12 hours)

Fundamental relationships for flow and transport - general principles, instantaneous equation for fluid flow and transport, Reynold's time-averaged mean flow and transport equations, model resolution, solution techniques, data requirements.

Measurement and analysis of flow - measurement of velocity and flow, tracer studies, estimating design flows.

Module II (11 hours)

Models for rivers and streams - completely mixed systems - reaction kinetics, mass balance and steady state solution, particular solutions, feed-forward systems of reactors, feed-back systems of reactors, computer methods.

Incompletely mixed systems - diffusion, distributed systems – steady and unsteady cases, steady state solutions, simple time variable solutions.

Module III (11 hours)

Rivers and streams- stream hydro-geometry, low- flow analysis, dispersion and mixings, flow model complexity and data requirements, estimating mixing in streams and rivers, hydraulic methods for steady and unsteady flows and solution techniques, routing and water quality problems

Mixing in lakes and reservoirs, water balance.

Transport and mixing in estuaries

Module IV (8 hours)

BOD and oxygen saturation, Streeter-Phelps equation, point and distributed sources.

Hydraulic analysis for grit chamber and upstream components, primary clarifier, aeration basin, final clarifier and chlorine contact basin in a typical water treatment plant.

References

1. Surface Water Quality Modeling: Steven. C. Chapra, McGraw Hill, Inc., 1997
2. Hydrodynamics & Transport for Water Quality Modeling. James L Martin & Steven C. McCutcheon, Lewis Publishers
3. Treatment Plant Hydraulics for Environmental Engineers: Larry D. Benfield, Joseph. F. Judkins, and A. David Parr. 1984.

CEU357 HYDROPOWER

L	T	P	Cr
3	0	0	3

Module I (12 hours)

Sources of energy - Hydropower – Place of hydropower in a power system – Fundamentals of Water Power Engineering- Classification of hydropower plants. Water power estimates – Essentials of stream flow for water power studies. Pondage and storage – effect of pondage on plant capacity. Benefits from storage. Basic Hydrology. Mass curve and flow duration curve. Effect of reservoirs on flood flow. Load curve and load factor. Utilisation factor. Capacity factor. Diversity factor. Firm Power and Secondary Power. Prediction of load.

Module II (10 hours)

Run of river plants. Pumped storage plants. General arrangement of power house. Types of power house. Mini and micro hydel plants. Tidal Power Plants.

Module III (10 hours)

Intakes. Forebay. Gates. Penstocks, Canals and Tunnels. Joints. Anchor Blocks. Bends and Manifolds. Valves. Water Hammer. Surges and Surge Tanks.

Module IV (10 hours)

Turbines and Generators. Flood routing through reservoirs. Cost and value of water power.

References

1. Creager and Justin, Hydroelectric Engineering Handbook, John Wiley and Sons.
2. Barrows, H.K., Water Power Engineering, Mc Graw Hill Inc.
3. Mosonyi, Water Power Development, Hungarian Academy of Sciences.
4. Guthrie Brown, Hydroelectric Engineering Practice, Blackie and Sons Ltd; London.
5. Dandekar and Sharma, Water Power Engineering, Vikas Publishing House (P) Ltd.
6. Nigam, P.S., Handbook of Hydro Engineering. Nem Chand and Sons, Roorkee, 1999.
7. Zheng Naibo et al, Mini Hydropower, John Wiley and Sons, 1997.
8. UNIDO, Small Hydropower Series, UN, 1983.
9. Smail Khennas and Andrew Barnett, Best Practices for Sustainable Development of Mini Hydropower in Developing Countries, World Bank/ESMAP, 2000.
10. CBIP Journal and Publications.
11. Journal of Water Power and Dam Construction.
12. Indian Journal of Power and River Valley Development.

CEU358 TRAFFIC ENGINEERING

Prerequisite CEU215 Transportation Engineering I

L	T	P	Cr
3	0	0	3

MODULE I (7 hours)

Scope of Traffic Engineering & Study of its Elements: Introduction - Objectives and scope of traffic engineering - Components of road traffic: vehicle, driver and road - Road user and vehicle characteristics and their effect on road traffic - Traffic maneuvers.

MODULE II (11 hours)

Traffic Engineering Studies and Analyses: Objectives, methods, equipment, data collection, analysis and interpretation (including case studies) of (a) Speed and delay, (b) Origin and destination, (c) Parking, (d) Accident & other studies

MODULE III (12 hours)

Design, Regulation and Management of Traffic Engineering Facilities: Control of traffic movements through time sharing and space sharing concepts - Design of channelising islands, T, Y, skewed, staggered, roundabout, mini-roundabout and other forms of at-grade crossings including provision for safe crossing of pedestrians and cyclists - Grade separated intersections: Warrants and design features - Bus stop location and bus bay design - Road lighting - Regulations on vehicles, drivers and traffic - Planning and design of traffic management measures: one-way streets, reversible lanes and roadways, turn regulation, transit and carpool lanes - Planning and design of pedestrian facilities.

MODULE IV (12 hours)

Traffic Control Devices & Environmental Control: Different methods of signal design - Redesign of existing signals including case studies - Signal coordination - Air & Noise pollution of different transport modes - Visual impacts - Impacts on land development - Technological approaches to improving environment

References

1. Pignataryo L., Traffic Engineering - Theory & Practice, John Wiley, 1973.
2. Kadiyali L.R., Traffic and Transport Planning, Khanna Publishers, Sixth Edition, 1997.
3. The Institute of Transportation Engineers, Transportation and Traffic Engineering Hand Book, Prentice Hall, Chapters 8,17,21,23 and 24,Third Edition, 1965.
4. O' Flaherty C.A., Highways-Traffic Planning & Engineering, Edward Arnold, 1997.
5. McShane W.R. & Roess R.P., Traffic Engineering, Prentice Hall, 1990.
6. IRC-SP41, Guidelines for the Design of At-Grade Intersections in Rural & Urban Areas
7. Salter R.J., Highway Traffic Analysis and Design, ELBS
8. Matson, Smith & Hurd, Traffic Engineering, McGraw Hill Book Co.

CEU359 ADVANCED SURVEYING

Prerequisite CEU205 Surveying

L	T	P	Cr
3	0	0	3

Module 1(10 hours)

Field astronomy - definitions - solution of an astronomical triangle - co-ordinate systems - time - solar, sidereal and standard equation of time - sundial - determination of time, azimuth, latitude and longitude.

Module 2 (10 hours)

Map Projection: introduction - methods of projection – electronic distance measurement – principle – reduction of E.D.M lines - geodimeter – tellurimeter - total station – global positioning system.

Module III (12 hours)

Photogrammetry – terrestrial and aerial photogrammetry – heights and distances from Photographs – flight planning – elements of stereoscopy – photo mosaic – photo interpretation – applications of photogrammetry.

Module IV (10 hours)

Remote sensing – introduction – electromagnetic radiation – target interactions – remote sensing systems – remote sensing from space – applications of remote sensing.

References

1. Punmia .B.C., Surveying – Vol. III, Laxmi Publications, 1993.
2. Joshi M.D. & Jawaharlal Sharma, Text Book of Advanced Surveying, CBS Publishers, 1985.
3. Agor,R.Advanced Surveying, Khanna Publisher, 1981.
4. Arora.K.R., Surveying – Vol III, Standard Publishers, 1993
5. Ram Pal K.K. Text Book of Photogrammetry, Oxford Publishers.
6. S.K Duggal. Surveying Vol.II, Tata McGrawHill, 2004.

CEU360 ADVANCED STRUCTURAL ANALYSIS

L	T	P	Cr
3	0	0	3

Prerequisite CEU301 Structural Analysis II

Module 1 (11 hours)

Approximate methods of analysis of multistorey frames

Analysis for vertical load - substitute frames - loading condition for maximum positive and negative bending moment in beams and maximum bending moment in column - analysis for lateral load - portal method - cantilever method and factor method

Matrix analysis of structures

Static and kinematic indeterminacy - force and displacement methods of analysis - definition of flexibility and stiffness influence coefficients - development of flexibility matrices by physical approach

Module II (14 hours)

Flexibility method: flexibility matrices for truss and frame elements - load transformation matrix - development of total flexibility matrix of the structure - analysis of simple structures - plane truss and plane frame - nodal loads and element loads - lack of fit and temperature effects

Stiffness method: development of stiffness matrices by physical approach - stiffness matrices for truss and frame elements - displacement transformation matrix - development of total stiffness matrix - analysis of simple structures - plane truss and plane frame - nodal loads and element loads - lack of fit and temperature effects

Module III (9 hours)

Direct stiffness method

Introduction - element stiffness matrix - rotation transformation matrix - transformation of displacement and load vectors and stiffness matrix - equivalent nodal forces and load vectors - assembly of stiffness matrix and load vector - determination of nodal displacements and element forces - analysis of plane truss - plane frame (with numerical examples) - analysis of grid - space-truss and space-frame (without numerical examples)

Module IV (8 hours)

Computer Implementation

A project on development of an analysis program using some of the above method is envisaged at this stage

Introduction to Analysis Packages

The numerical examples solved using the analysis program developed in the above to be verified using common commercial packages.

References

1. Wang C.K., Matrix Methods of Structural Analysis, International Textbook Company, 1970.
2. Przemieniecki J.S., Theory of Matrix Structural Analysis, McGraw Hill, New York, 1985.

CEU361 FINITE ELEMENT METHOD—WEIGHTED RESIDUAL APPROACH

L	T	P	Cr
3	0	0	3

Module 1 (9 hours)

Boundary value problems and the need for numerical discretisation:

Introduction, examples of continuum problems, history of finite element method.

Weighted residual methods:

Approximation by trial functions, weighted residual forms, piecewise trial functions, weak formulation, Galerkin method, examples of one-, two- and three-dimensional problems.

Module II (11 hours)

Higher order finite element approximation:

Degree of polynomial in trial functions and rate of convergence, the patch test, shape functions for C^0 and C^1 continuity, one-, two- and three-dimensional shape functions.

Isoparametric formulation:

The concept of mapping, isoparametric formulation, numerical integration, mapping and its use in mesh generation.

Module III (11 hours)

Variational methods:

Variational principles, establishment of natural variational principles, approximate solution of differential equations by Rayleigh-Ritz method, the use of Lagrange multipliers, general variational principles, penalty functions, least-square method.

Partial discretisation and time-dependent problems:

Partial discretisation applied to boundary value problems, time-dependent problems via partial discretisation, analytical solution procedures, finite element solution procedures in time domain.

Module IV (11 hours)

Generalised finite elements and error estimates:

The generalised finite element method, the discretisation error in a numerical solution, measure of discretisation error, estimate of discretisation error.

Coordinate Transformation:

Transformation of vectors and tensors, transformation of stiffness matrices, degree of freedom within elements, condensation, condensation and recovery algorithm, substructuring, structural symmetry.

References

1. Zienkiewicz, O.C., and Morgan, K., Finite Element Approximation, John Wiley & Sons, 1983.
2. Reddy, J.N., An Introduction to the Finite Element Method, McGraw Hill, 2006.
3. Huebner, K.H., Thornton, E.A., and Byrom, T.G., The Finite Element Method for Engineers, John Wiley & Sons, 1995.
4. Hutton, D.V., Fundamentals of Finite Element Analysis, McGraw Hill, 1991.
5. Kikuchi, N., Finite Element Methods in Mechanics, Cambridge University Press, 1986.
6. Cook, R.D., Malkus, D.S., Plesha, M.E., and Witt, R.J., Concepts and Applications of Finite Element Analysis, John Wiley & Sons, 2003.
7. Zienkiewicz, O.C., and Taylor, R.L., The Finite Element Method, Vols I to III, McGraw Hill, 1999.

CEU421 WATER RESOURCES SYSTEMS PLANNING AND DESIGN

Prerequisite CEU212 Hydro Systems

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Introduction: Water systems engineering –scope and approach.

Issues and the systems planning approach- water system dynamics- water resource development alternatives – Water systems

planning objectives- Constraints and Criteria – Economic and Econometric principles

Module II (10 hours)

Hydrologic input analysis, Demand analysis, System elements & Subsystem planning - Stochastic planning and management - Design and management issues.

Module III (12 hours)

Optimization methods and their application in W.R. systems. Linear programming and Dynamic programming models. Problem formulation for W.R systems – Multi objective planning – Large scale system analysis- Case studies.

Module IV (10 hours)

Ground water system planning – Conjunctive surface and G.W development- Hierarchical approach- Water quality management planning- Regional planning- Policy issues.

References

1. M. C. Chaturvedi , W.R. Systems – Planning & Management, Tata Mc Garw Hill Publications, New Delhi
2. Louks D P etal W.R System Planning & Analysis, Prentice Hall - 1981.
3. Maass. A. etal – Design Water Resources Systems – Mc. Millan. 1968
4. Goodman. A.S. Principles of Water Resources planning, Prentice – Hall, 1984

CEU422 SOIL DYNAMICS & DESIGN OF MACHINE FOUNDATIONS

Prerequisite CEU303 Geotechnical Engineering I

L	T	P	Cr
3	0	0	3

Module I (11 hours)

Introduction - nature of dynamic loads - stress conditions on soil elements under earthquake loading - dynamic loads imposed by simple crank mechanism - type of machine foundations - special considerations for design of machine foundations - theory of vibration: general definitions - properties of harmonic motion - free vibrations of a mass-spring system - free vibrations with viscous damping - forced vibrations with viscous damping - frequency dependent exciting force - systems under transient forces - Raleigh's method - logarithmic decrement - determination of viscous damping - principle of vibration measuring instruments - systems with two degrees of freedom - special response

Module II (11 hours)

Criteria for a satisfactory machine foundation - permissible amplitude of vibration for different type of machines - methods of analysis of machine foundations - methods based on linear elastic weightless springs - methods based on linear theory of elasticity (elastic half space theory) - methods based on semi graphical approach - degrees of freedom of a block foundation - definition of soil spring constants - nature of damping - geometric and internal damping - determination of soil constants - methods of determination of soil constants in laboratory and field based on IS code provisions

Module III (10 hours)

Vertical, sliding, rocking and yawing vibrations of a block foundation - simultaneous rocking, sliding and vertical vibrations of a block foundation - foundation of reciprocating machines - design criteria - calculation of induced forces and moments - multi-cylinder engines - numerical example (IS code method)

Module IV (10 hours)

Foundations subjected to impact loads - design criteria - analysis of vertical vibrations - computation of dynamic forces - design of hammer foundations (IS code method) - vibration isolation - active and passive isolation - transmissibility - methods of isolation in machine foundations

Note: Use of I.S 2974 Part I and II will be allowed in the examination.

References

1. Shamsheer Prakash, Soil Dynamics, McGraw Hill, 1981.
2. Alexander Major, Dynamics in Soil Engineering, Akademiai, 1980.
3. Sreenivasalu & Varadarajan, Handbook of Machine Foundations, Tata McGraw Hill
4. IS 2974 - Part I and II, Design Considerations for Machine Foundations
5. IS 5249: Method of Test for Determination of Dynamic Properties Of Soils

CEU423 TRANSPORTATION PLANNING

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Urban Transportation Planning Process & Concepts: Role of transportation - Transportation problems - Urban travel characteristics - Evolution of transportation planning process - Concept of travel demand - Demand function - Independent variables - Travel attributes - Assumptions in demand estimation - Sequential, recursive and simultaneous processes

Module II (12 hours)

Trip Generation Analysis: Definition of study area - Zoning - Types and sources of data - Road side interviews - Home interview surveys - Expansion factors - Accuracy checks - Trip generation models - Zonal models - Category analysis - Household models - Trip attractions of work centers.

Module III (10 hours)

Trip Distribution Analysis: Trip distribution models - Growth factor models - Gravity models - Opportunity models.

Module IV (10 hours)

Mode Split Analysis: Mode split analysis - Mode choice behaviour, Completing modes, Mode split curves, Probabilistic models.

Route Split Analysis - Route split analysis: Elements of transportation networks, coding - minimum path trees, all-or-nothing assignment.

References

1. Hutchinson B.G., Principles of Urban Transportation System Planning, McGraw Hill
2. Khisty C.J., Transportation Engineering – An Introduction, Prentice Hall, 3rd Edition, 2002.
3. Bruton M.J., Introduction to Transportation Planning,
4. Papacostas, Fundamentals of Transportation Planning, Tata McGraw Hill, Third Edition, 2002.
5. Dicky J.W., Metropolitan Transportation Planning, Tata McGraw Hill,

CEU424 ADVANCED CONCRETE DESIGN

L	T	P	Cr
3	0	0	3

Prerequisite CEU312 Structural Concrete Design

Module 1 (12 hrs)

Large span concrete roofs

Introduction– classification- behaviour of flat slabs - direct design and equivalent frame method- codal provisions - waffle slabs.

Shells and Folded plates

Forms of shells and folded plates- structural behaviour of cylindrical shell and folded plate-method of analysis- membrane analysis – beam arch approximation- codal provisions- design of simply supported circular cylindrical long shells and folded plates.

A design project involving the complete design of one of the above is envisaged at this stage

Module II (12 hrs)

Deep beams

Analysis of deep beams- design as per BIS - design using strut and tie method.

Chimneys

Analysis of stresses in concrete chimneys- uncracked and cracked sections- codal provisions- design of chimney.

A project involving the design of a deep beam and concrete chimney is envisaged at this stage.

Module III (10 hrs)

Water tanks

Introduction- rectangular and circular with flat bottom- spherical and conical tank roofs- staging- design as per BIS.

A project involving the design and detailing of a water tank is envisaged at this stage.

Module IV (8 hrs)

Bridges

General – IRC Bridge code –loading standards–impact effect – wind load – longitudinal forces – centrifugal forces – force due to water currents – buoyancy effect – temperature effects – secondary stresses – erection – seismic force

Design of slab culvert – R.C box culverts –T-beam bridges – Concept on design of continuous bridges, balanced cantilever bridges, arch bridges and rigid frame bridges.

A project involving the design and detailing of a slab culvert/ T-beam bridge is envisaged at this stage.

References

1. Purushothaman. P, Reinforced Concrete Structural Elements-, Tata Mc Graw Hill, 1986
2. G.S.Ramaswamy, Design and Construction of Concrete Shell Roofs-CBS publishers, 1986
3. Ashok K Jain, Reinforced Concrete –Nem Chand Bros. Roorkee , 1998
4. Jain & Jaikrishna, Plain and Reinforced Concrete – Vol I & II, NemChand Bros., Roorkee, 2000.
5. Taylor C Pere, Reinforced Concrete Chimneys, Concrete publications, 1960
6. Design of deep girders, Concrete Association of India, 1960
8. Mallick & Gupta, Reinforced Concrete, - Oxford & IBH, 1982
9. BIS codes (IS 456 , IS 2210, IS 4998, IS 3370, SP 16, SP 24, SP 34).
10. IRC Codes (IRC 5, IRC 6, IRC 21)

CEU425 ENVIRONMENTAL SOIL PHYSICS

L	T	P	Cr
3	0	0	3

Module 1 (10 hours)

General physical characteristics of soils - weathering, soil formation, soil profile, soil as a three phase system, volume and mass relationships.

Properties of water in relation to porous media - molecular structure, hydrogen bonding, states of water, ionization and pH, solvent properties, osmotic pressure, solubility of gases, adsorption, vapour pressure, surface tension, capillarity, compressibility.

Particle size analysis and specific surface measurement, nature and behavior of clay, soil structure and aggregation.

Module II (12 hours)

Content and potential of soil water - measurement of soil wetness, water potential, soil-moisture characteristic curve, hysteresis, measurement of soil moisture potential.

Flow of water in saturated and unsaturated soils – basic terminology, laws and equations.

Movement of solutes and soil salinity - basic processes, equations, soil salinity & alkalinity, salt balance

Module III (10 hours)

Content and composition of soil air - composition of soil air, soil respiration and aeration requirements, measurement of soil air content and composition, respiration, oxidation – reduction processes.

Movement and exchange of gases in the soil – processes.

The field water cycle – entry for water into soil, basic infiltration theory & equations, instability of wetting fronts, surface run off and erosion, redistribution of water in soil, drainage, evaporation.

Module IV (10 hours)

Soil – water plant relationships – uptake of soil moisture by plants, water balance and energy balance in the field, classical and modern concepts of soil water availability, irrigation and water – use efficiency, remediation of hazardous waste sites .

References

1. Daniel Hillel, Environmental Soil Physics, Academic Press, 1998
2. H, Don Scott, Soil Physics - Agricultural and Environmental Applications, Iowa State University Press
3. Daniel Hillel, Introduction to Soil Physics, Academic Press, 1997
4. W.A Jury, W.R, Gardner, W.H.Gardner, Soil Physics John Wiley and Sons, 1991.

CEU426 INDUSTRIAL WASTE ENGINEERING

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Nature and characteristics of Industrial wastes- prevention versus control of industrial pollution- Linkage between technology and pollution prevention- tools for clean processes- reuse, recycle, recovery, source reduction, raw material substitution, toxic use reduction and process modification- separation technologies as tools for waste minimization- Flow sheet analysis- Energy and resource audits-waste audits

Module II (11 hours)

Preliminary treatment of industrial waste water – volume reduction – strength reduction – neutralization – equalization and proportioning
Treatment of industrial waste- suitability of different techniques- disposal of industrial waste

Module III (10 hours)

Effluent generation from textile industry – paper industry – dairy – fertilizer – thermal power plants- effluent characteristics- treatment

Module IV (11 hours)

Environmental impact of textile industry – paper industry - dairy - fertilizer – thermal power plant
Study of damages caused by industrial pollution in India and Kerala (typical problems).

References

1. Nemerow, N, Theory and Practices of Industrial Waste Treatment, Addison Wiley(1963)
2. Agardy ,Franklin J. Strategies of Industrial and Hazardous Waste Management, John Wiley & Sons (1998)
3. Nemerow Nelson Leonard Industrial Waste Treatment: Contemporary Practice and Vision for the Future, Butterworth-Heinemann (2006)
4. Larry W Canter, Environmental Impact Assessment, McGraw Hill, Inc., (1996)

CEU427 DESIGN OF EXPERIMENTS

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Basic concepts - calibration standards - generalized measurement system - experiment planning

Analysis of experimental data - causes and types of experimental errors - error analysis - statistical analysis of experimental data

Module II (11 hours)

Basic electrical measurements and sensing devices - analog and digital instruments

Displacement and area measurement - gauge blocks - optical methods - graphical and numerical methods for area measurement

Module III (11 hours)

Pressure measurements - pressure gauges

Flow measurement - laser dropller anemometer - impact pressure in supersonic flow

Module IV (10 hours)

Force, torque and strain measurements- the unbounded resistance strain gauge

Motion and vibration measurement - seismic measurement - data acquisition and processing.

References

1. Holman J.P, *Experimental Methods for Engineers*, McGraw Hill Publication, 1984.
2. Doebelin E.O, *Measurement Systems - Application and Design*, McGraw Hill Publication
3. Nukra B.C & Choudhary, *Instrumentation Measurement and Analysis*, Tata McGraw Hill Publication

CEU428 STATISTICAL MODELLING TECHNIQUES IN WATER RESOURCES ENGINEERING

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Introduction - uncertainty in real world information, design and decision making under uncertainty.

Basic concepts of probability and probability distributions – events , probability and random variables , elements of set theory , univariate and bivariate probability distributions, marginal distributions, conditional distributions , independence, derived distributions , mixed distributions, applications .

Properties of random variables - moments and expectation for univariate distributions, moment generating functions, measures of central tendency, dispersion, symmetry & skewness, moments and expectation for jointly distributed random variables, sample moments, parameter estimation, applications.

Module II (12 hours)

Some Discrete Probability Distributions and their Applications - Bernoulli process – binomial, geometric and negative binomial distributions, Poisson process - Poisson, exponential and gamma distributions, hyper geometric distribution, multinomial distribution, multivariate distributions – bivariate normal distribution.

Some Continuous Probability Distributions and their Applications – uniform distribution, exponential distribution, gamma distribution , beta distribution , Weibull distribution, normal distribution, lognormal distribution, extreme value distributions, some important distributions of sample statistics – chi-square, the t and F distribution, probability plotting and frequency analysis, applications.

Module III (10 hours)

Confidence Intervals and Hypothesis Testing – properties of estimators, estimation of confidence intervals, Hypothesis testing, goodness of fit tests , analysis of variance - one way and two way analysis of variance. Methods of regression & correlation analysis - simple linear and multiple linear regression, frequency analysis of extreme events – EV distributions, applications.

Module IV (10 hours)

Simulation Techniques for Design - Monte Carlo simulation, generation of random numbers, variance reduction techniques, applications.

Risk and Reliability Analysis – analysis and assessment of reliability, measures of reliability, uncertainty in reliability assessments, first order analysis of uncertainty, temporal reliability, reliability based design, applications.

References

1. C.T Haan, Statistical Methods In Hydrology, Affiliated East West Press, 1994
2. N.T Kottegoda & Ranzo Russo, Statistics, Probability and Reliability For Civil and Environmental Engineers, Mc Graw Hill Inc., 1997
3. Alfredo H-S. Ang and W.H. Tang, Probability Concepts in Engineering Planning and Design, Vol. 1 : Basic Principles and Vol. 2 : Decision, Risk and Reliability : John Wiley & Sons, 1984

CEU429 COASTAL ENGINEERING

L	T	P	Cr
3	0	0	3

Module 1 (12 hours)

Introduction: Coastal Engineering – Coastal Environment – Problems, Coastal water level fluctuations – Tides- surges and seiches.

Waves: Linear wave theory - Irregular and regular waves –Short and long term wave analysis – wind generated waves-wave fore casting – Wave transformations- shoaling- refraction – reflection – diffraction – breaking.

Module II (10 hours)

Wave structure interaction – Forces on shore structures due to breaking, broken and attacking waves. Shore Protection , Type of beaches,Methods of shore protection, Shore protection Structures – break waters of different types – sea walls – groynes etc

Module III (10 hours)

Shores and Shore processes, long term and short term changes, Cross shore and long shore currents – Sediment transport - Onshore offshore movement of sediment – longshore transport-mathematical modeling - factors affecting equilibrium of beaches- Coastal erosion and protection along Kerala coasts.

Module IV (10hours)

Coastal zone Management: Coastal resource planning and management, Management Goals and Purposes, Sustainable use of resources, Application of IT in coastal zone management. Coastal Ecosystems - Activities in marine areas and environmental problems – Coastal laws.

References

1. Kamphius JW, Introduction to Coastal Engineering and Management, World Scientific 1999.
2. Sorenson RM, Basic Coastal Engineering, J.Wiley & Sons
3. Shore Protection Manuel Vol I &Vol II, U.S. Army Coastal Engineering Research Center
4. John R. Clark, Coastal Zone Management Handbook University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, Florida 2440 East Commercial Boulevard, Ft. Lauderdale, Florida 33308
5. R.G. Dean, and R.A. Dalrymple, Coastal Processes with Engineering Applications, Cambridge University Press.

CEU430 ADVANCED GEOTECHNICAL ENGINEERING

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Soil structure interaction problems: introduction with practical examples

Soil models : Single parameter model (Winkler), Two parameter models (Filonenko-Borodich model, Pasternak model, Hetengi model) – Visco – elastic model, Elastic continuum model. (only outline of salient features and discussion of limitations of the models is expected) – Contact pressure distribution beneath a rigid footing- concentrically and eccentrically loaded cases. Contact pressure distribution beneath flexible footings.

Contact pressure distribution below rafts – Parameters affecting contact pressure distribution
Method of analysis of contact pressure distribution – Modulus of subgrade reaction approach (Winkler model) – Classical solution of beams on elastic foundation – Solution for beam of infinite length subjected to central concentrated load and central moment – Beams of finite length – Formulation of basic equations for slabs resting on elastic foundation – Application to design of combined footings

Module II (9 hours)

Sheet pile walls and cofferdams : Types and uses of sheet piles – Design of cantilever and anchored sheet pile walls -Anchors – Types and uses of coffer dams – Single wall coffer dams – Soil pressure on single walled (braced cofferdams) – Design of single wall cofferdams – Cellular stability of cellular cofferdams – Instability due to heave of bottom of excavation – Condition for piping – Conditions for blow in

Module III (13 hours)

Machine foundations : Basic theory of vibration – Free and forced vibration of single degree of freedom with and without damping – Two degrees of freedom with and without damping – Dynamic soil properties – Mass spring model and constants – Elastic half space approach – Determination of dynamic soil constants in laboratory and field based on I.S code provisions. Modes of vibration of block foundation

Natural frequency of foundation soil system by Barkan's approach – Method of analysis – Barkan's method – Verticals- Translation, sliding, rocking and yawing (I.S code method)

Module IV (10 hours)

Special foundation : Shell foundations – Structural form and efficiency – Different types of shell foundations – General principles of design of shell foundations – Special features of the foundations for water tanks, silos, chimneys and transmission line towers

Foundations for offshore structures – Gravity structures – Jack up type structures – Design considerations

References

1. Shamsheer Prakash, Soil Dynamics, McGraw Hill, 1981.
2. Alexander Major, Dynamics in soil Engineering, Acamemiai, 1980.

CEU451 ADVANCED STEEL DESIGN

L	T	P	Cr
3	0	0	3

Prerequisite CEU302 Principles of Structural Design

Module I (12 hours)

Gantry Girder

Design of gantry girder – gantry to column connection.

Water Tanks

Design of rectangular, pressed steel tanks – design of suspended bottom tanks – cylindrical tank with hemispherical bottom – design of staging.

A design project involving the design and detailing of a gantry girder and water tank is envisaged at this stage

Module II (10 hours)

Chimneys

Design of self supporting chimney – design principles of guyed chimney.

Bunkers, Silos

Introduction– Janssen’s theory– Airy’s theory– design criteria.

Transmission Towers

Introduction–loads on towers– analysis–design of members and foundation.

A design project involving the design of any of the above structures is envisaged at this stage

Module III and IV (20 hours)

Plate girder bridges

Plate girders – loads – equivalent uniformly distributed loads – Indian railway code of practice – design of plate girder bridges – bearings.

Light gauge members – Light gauge sections – design considerations – allowable stresses – buckling, design of compression members, tension members and laterally supported beams – connections.

A design project involving the design of a plate girder bridge and a light gauge structure is envisaged at this stage

References

1. Ramchandra , Design of Steel Structures Vol I and II, Standard book house , 1991
2. P. Dayaratnam, Design of Steel Structures, (Wheeler),1998
3. M. Raghupathi, Design of Steel Structures, Tata McGraw Hill, 1985
4. Lin & Breslar, Design of Steel Structures, John Wiley & Sons, 1963
5. BIS codes (IS 800, SP 6,IS 804, IS 805,IS 6533, IS 9178, IS 801,IS 811)

CEU452 EARTH AND ROCKFILL DAM ENGINEERING

L	T	P	Cr
3	0	0	3

Module I (11 hours)

Introduction: use of earth and rockfill dams - general features of earth and rockfill dams - types of earth dams - materials available for embankment construction - character of foundation - climate - shape and size of valley - river diversion - probable wave action-time available for construction - function of reservoir -earthquake activity - study of typical embankment sections including earth dams on Kerala.

Exploration for foundation and embankment construction materials: influence of topography and sub-soil conditions on site selection - foundation subsurface exploration - studies of embankment construction materials

Module II (11 hours)

Earth dam design: Basic consideration in design - location and alignment of dam - design of foundation - embankment design - design of internal drainage system - embankment details - design of appurtenances - design of provisions to control pore pressure - earth dams on pervious foundations - methods of foundation treatment - prevention of under seepage with complete vertical barrier - reducing under seepage - controlling under seepage - special design problems - measuring instruments and performance observations - design considerations on earthquake regions - loose sand foundation - foundations of soft clay and silt - upstream slope wave protection - down stream slope protection

Module III (10 hours)

Construction of earth dams: phases of construction - site preparation - river diversion and cofferdam construction - foundation preparation - borrow pit excavation - fill placement - soil compaction - construction control - slope treatment and riprap

Measurement of movements and pore water pressures: embankment movements during construction - post construction embankment movement - pore water pressures during construction - pore pressure measuring equipment

Rockfill dams: general features - materials - design of rockfill dams and components - facing with different materials - spillways and free board - core wall type - earth core type - construction of rockfill dams

Hydraulic fill dams: general features - analysis of hydraulic fill dams - construction details

Module IV (10 hours)

Advanced theory of seepage and shear strength: seepage pressure - quick conditions - laplace equation - flownet phreatic line on earth dam - a Casagrande's solution - Shaffernak and Van Iterson solution - Leo Casagrande solution - piping and exit gradient - Khosla's theory - composite profile - Schwarz Christoffel transformation - determination of permeability in soil-rock - longitudinal test - radial test - shear tests on rock - single jack test - direct shear test on rock cubes -punch shear test - shear box tests - tensile strength tests on rock - brazilian test - flexural strength for bending test - young's modulus by bending test and brazilian tests

Stability analysis: Standard methods of analysis - Taylor's modified swedish method including side forces between slices - wedge method (sliding block) - stability conditions during construction - full reservoir and draw down conditions - pore pressure due to gravity seepage after instantaneous draw downs

References

1. Sowers G.F., Earth and Rockfill Dam Engineering, Asia Publishing
2. Sherad et al J.L., Earth & Earth Rock Dams- Engineering Problems of Design & Construction, John Wiley
3. Thomas H.H., Engineering of Large Dams-Part II
4. Verma B.P., Rock Mechanics for Engineers

CEU453 ENVIRONMENTAL POLLUTION CONTROL

ENGINEERING

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Environmental pollution - interrelationship between various forms of pollution - surface water pollution surveys - integrated river basin water management - restoration of water bodies - water quality changes by domestic use - radioactive materials - thermal pollution and underground disposal - types of water pollutants and their effects - instrumentation for water quality and treatment

Module II (11 hours)

Air pollution control strategy – air pollution control technology – methodological factors affecting air pollution – air pollution surveys – instrumentation for air quality measurement – air quality standards

Module III (11 hours)

Land pollution – land pollution surveys - ecological aspects of vegetation control
Noise pollution - effects of noise - sources – noise control techniques - instruments for noise measurement

Light and glare pollution – outside lighting and glare sources - corrective procedures

Module IV (10 hours)

Water pollution laws and regulations

Air pollution control Act of India

Land pollution laws and regulations

The Environment (Protection) act, 1986

References

1. Rao C.S., Environmental Pollution Control Engineering, New Age International (P) Ltd, 1993.
2. Goel P.K., Water Pollution Causes, Effects & Control, New Age International (P) Ltd.
3. Birdie G.S. & Birdie J.S., Water Supply & Sanitary Engineering, Dhanapat Raj & Sons, 1997.
4. Liptak Bela G., Environmental Engineers Hand Book Vols I, II & III

CEU454 ENVIRONMENTAL IMPACT ANALYSIS OF CIVIL ENGINEERING PROJECTS

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Concept of environment – concept of environmental impact – Environmental impact assessment (EIA), definitions and concepts, sustainable development (SD), initial environmental examination (IEE), environmental impact statement (EIS), environmental appraisal, environmental audit (EA)

Module II (11 hours)

Environmental baseline- Impact assessment methods- checklists- matrices- quantitative methods- networks- overlay mapping. Introduction to impact prediction and evaluation-Socio-economic impact prediction - history of SIA - the scope of socio-economic impacts-Economic impacts - establishing the economic baseline - predicting direct and indirect economic impacts

Module III (10 hours)

Impact of urban development- case studies

Impact of Water resources projects- Reservoirs- canals- case studies

Module IV (11 hours)

Impact of transportation projects- highways-case studies

Impact of waste treatment and disposal methods- incinerators- land fills- impact of disposal of waste into surface waters

References

1. Larry W Canter, Environmental Impact Assessment, McGraw Hill, Inc., 1996
2. Betty Bowers Marriot, Environmental Impact Assessment A Practical Guide, McGraw Hill, Inc., 1997.
3. C.J. Barrow, Environmental & Social Impact Assessment – An Introduction, Edward Arnold, 2002.
4. Evan. K. Paleologos and Ian Lerche, Environmental Risk Analysis, McGraw Hill Inc., 2001
5. Peter Morris (ed.) and Riki Therivel (ed.), Methods of Environmental Impact Assessment, Routledge, 2001.

CEU455 MULTIVARIATE DATA ANALYSIS

L	T	P	Cr
3	0	0	3

Module I (12 hours)

Introduction - overview of multivariate data analysis - vector random variables - multivariate normal distributions - mathematics of multiple - canonical and partial correlations - polynomial curve fitting - tests of hypothesis on means and the t^2 statistics - numerical and research examples

Module II (12 hours)

Principal component and factor analysis - principal components of multivariate observations - geometrical meaning of principal components - the interpretations of the principal components - the mathematical model for factor structure - estimation of factor loadings - factor rotation - clustering sampling units and multi-dimensional scaling - numerical and research examples

Module III (10 hours)

Multivariate analysis of variance (MAV) - multivariate general linear model - multivariate analysis of variance and co-variances - multiple comparisons in MAV - profile analysis - curve fitting for repeated measurements - numerical and research examples

Module IV (8 hours)

Mathematics of discriminate and classification statistics - estimation of the misclassification probabilities - classification for several groups - numerical and research examples

References

1. Cooley W.W. & Lohnner P.R., Multivariate Data Analysis, John Wiley, 1971.
2. Morrison D.F., Multivariate Statistical Methods, McGraw Hill, Publishing co.
3. Anderson T.W., An Introduction to Multivariate Statistical Analysis, John Wiley, 2003.

CEU456 DATA STRUCTURES AND ANALYSIS

L	T	P	Cr
3	0	0	3

Module I (9 hours)

Review of data types – scalar types – primitive types – enumerated types – sub ranges structures types – character strings – arrays – records – sets – tiles – data abstraction – complexity of algorithms – analysis of recursive algorithms

Module II (10 hours)

Linear data structures – stacks – queues – lists – stack and queue implementation using array – linked list – linked list implementation using pointers

Module III (11 hours)

Non linear structures – graphs – trees – sets – graph and tree implementation using array linked list – set implementation using bit string linked list

Module IV (12 hours)

Searching – sequential search – searching arrays and linked lists – binary search – searching arrays and binary search trees – hashing – introduction to hash functions – sorting n^2 sorts – bubble sort.

References

1. Aho A.V., Hopcroft J.E nad Ullman J.D, Data Structures and Algorithms, Addison Wesley publications
2. Sahini S., Data Structures, Algorithms and Applications in C++, McGraw Hill Publications
3. Wirth N., Algorithms + Data Structures = Programs, Prentice Hall Publication

CEU457 ADVANCED ENVIRONMENTAL ENGINEERING

Prerequisite To have registered for CEU311 Environmental Engineering I

L	T	P	Cr
3	0	0	3

Module I (10 hours)

Instrumental methods for analysis of contaminants in air, water and soil- colorimetry, chromatography, spectroscopy, electrochemical probes

Advances in settling and filtration of water and wastewater- tube settlers, dual media and multimedia filters, micro filters

Module II (10 hours)

Advances in waste water treatment – extended aeration – bio filtration –Advances in anaerobic digestion- Up flow anaerobic sludge blanket reactor

Tertiary treatment – disinfection of waste water- waste water recycling

Module III (11 hours)

Stream sanitation – kinetics of stabilization – Streeter-Phelps equation- zones of pollution in a stream – self purification of natural waters.

Treatment and disposal of Hazardous wastes- Radioactive, nuclear and biomedical waste

Noise pollution – instruments and techniques for noise measurement

Module IV (11 hours)

Indoor and out door air pollution- meteorology-influence of solar radiation and wind fields- lapse rate and stability conditions- characteristics of stack plumes- effective stack height

Characteristics and health effects of various air pollutant particulates (PM2.5, PM10) and gaseous pollutants (CO, NO_x, SO_x, etc)- their behaviour in atmosphere- monitoring

Photochemical reactions- secondary pollutants

References

1. Metcalf & Eddy, Waste Water Engineering Treatment Disposal Reuse, Tata McGraw Hill 3rd edition ,2002
2. Clarence, J.Velz, Applied Stream Sanitation, John Wiley and sons, 1970.
3. C.S Rao, Environmental Pollution Control Engineering, John Wiley & Sons, Inc.1992.
4. Nevers, Noel De, Air pollution control engineering, McGraw-Hill,2000.