CE010 801 ADVANCED STRUCTURAL DESIGN

Teaching scheme: **Credit: 4**
3hours lecture and 2 hours tutorial per week

Objective:

To familiarize students with behavior and design procedure of some of the special structural elements so that they can perform better in the analysis and design of these structures in practical situations.

Module 1 (15 Hrs)
Road bridges: IRC Loadings and Specifications-T beam bridges – box culvert (Design forIRC Class A Loading only**)**- Bearings(Theory only)

Module 2 (15 Hrs)
Shell structures: general principles for membrane theory for symmetrical uniformly distributed load- design of a simply supported single barrel cylindrical shell for membrane stresses. Folded plates: general principles- structural behaviour of plates (design not required)

Module 3 (14 Hrs)
Industrial buildings: roof loads- design of trusses (analysis not required) -design of purlins-design of bracings and supporting system. (Problems not expected.)

Module 4 (15 Hrs)
Design of Plate girders and gantry girders- welded compound sections

Module 5(16 Hrs)
Steel bridges: IS specifications-design of highway and railway bridges of plate girder type.(Design of bracings not required.)
Note:
Sketches only required for reinforcement details. Detailed drawing in drawing sheets not required.

REFERENCES

1. IRC Bridge code,Indian railway bridge code, IS 456.IS 800,IS 875
2. Victor J D, Design of concrete bridges, oxford & IBH publishing company,new delhi
3. Krishna Raju, Advanced design of concrete structures, oxford & IBH publishing company,new delhi
4. Ramchandra, Design of steel structures vol 2 standard book house, delhi
5. Ramaswamy G S Design and construction of concrete shell roofs, Mc Graw Hill

CE010 802 BUILDING TECHNOLOGY AND MANAGEMENT

Teaching scheme: **Credits: 4**
2 hours lecture and 2 hours tutorial per week

Objective: *To impart theoretical knowledge as well as awareness to practical concepts in project implementation giving emphasis on three essentials of project management; (1) avoiding time over-run, (2) avoiding cost over-run, (3) maintaining total quality management*

Module 1 (12 Hrs)
Concrete Mix Design: General concepts. BIS method of mix design, American standards of mix design, IS-method of mix design, Durability concepts in mix design - Requirements and tests of materials required for mix design.-Fibre reinforced concrete- High performance concrete.
Form work. General arrangements – general requirements – common faults – materials for form work – form work arrangements – form work design – loads on forms – design procedure – form work vibration for compaction of concrete – stripping time and shoring.

Module 2 (12 Hrs)
Prefabricated construction: Advantages, foundation units, wall panels, frames for opening, walls–units for roofs and floors – low cost roof systems. Hollow concrete blocks, Ferro cement – use and application – modular co-ordination – method of production – flow line method – station method – manufacturing process for structural units.
Codification and Standerdisation- Value analysis: Various methods and techniques. Cost time analysis in Network Planning.

Module 3 (12 Hrs)
Construction company organization: Different types of organizational set up – construction team – objectives of civil engineering management – duties and responsibilities of a civil engineer – functions of construction management. Technical planning.
Site organization: Organization of labour, resources, materials, method of execution of the project – inspection and quality control- safety in construction.

Module 4 (12 Hrs)
Materials Management: Functions of materials management – inventory control techniques.
Construction contracts: Item rate contract – Lump-sum contract –Labour contract – Negotiated contract – Global contract – Percentage contract – Cost plus percentage contract- Cost plus fixed fee contract- Cost plus fluctuating fee contract – Target contract – All in contract.

Module 5 (12 Hrs)

Claims manual for a construction organization: Law of contract - Extra work and deviation order – claims – owner' s claim – sub contractor' s claim – disputes and arbitration – consequences of mistake in contracts – terms and conditions of contract – contract documents – earnest money – security deposit – warranty period – contract signed under coercion – contract signed by minors, insane or drunken persons – authority to agree and find, validity of an oral agreement – conditions and warranties – express terms and implied terms – voidable contracts and their performance – illegal and voidable contracts – liability for tort in contract- litigation – breach of contract and remedies – discharge of contract – equity, privity of contract – transfer of contractual rights and obligations.

References

1. Gambhir. M. L, Concrete Technology, Mcgrawhill
2. M .S Shetty, concrete technology, S. Chand & Co.
3. A.R Santhkumar-Concrete Technology-Oxford University Press
4. S. P Arora, Building constructions, Dhanpat Rai & sons, New Delhi.
5. B. L Gupta, Amit Gupta, Construction Management and accounts, standard publishers and Distributions.
6. Construction Management and accounts – V .N Vazirani.
7. Construction Engineering & Management, S. Seetharaman, Umesh Publications, Delhi.
8. Donald S Barrie & Boyd C Paulson - Professional Construction Management, Mc Graw Hill
9. P.S. Gahlot & B.M.Dhir , Construction Planning and Management, New agw International
10. Knatson, Conctruction Management fundamentals, McGraw Hill.

CE010 803 ENVIRONMENTAL ENGINEERING - II

Teaching scheme: **Credits: 4**

2 hours lecture and 2 hours tutorial per week

Objective:

- *To understand the basic principles of Wastewater Engineering*
- *To develop knowledge in unit operations and design of wastewater treatment systems*

Module 1 (10hrs)

Introduction to sanitary engineering. Sewerage systems – separate, combined and partially combined systems.

Quantity of sewage: sanitary sewage - sources, factors affecting. Fluctuations in sewage flow, peak factor.

Characteristics of sewage: physical, chemical and biological characteristics and analysis. population equivalent, relative stability.
Storm sewage: Factors affecting, intensity of rainfall, rational and empirical formula, time of concentration, intensity - duration curve and formula.

Design of sewers: Flow formula, minimum and maximum velocity of flow, effect of variation of discharge on velocity, use of partial flow diagrams, design of circular sewers, longitudinal and cross section of sewer lines.

Module 2 (10hrs)

Construction of sewers: Materials of sewers, crown corrosion.

Sewer appurtenances: inlets, catch basins, clean outs, manholes, drop manholes, lamp holes/flushing tanks, grease and oil traps, inverted siphons, storm regulators.
Sewage pumping: classification and capacity of pumps.

Natural methods of wastewater disposal: land disposal -. Sewage farming - disposal by dilution - self purification of streams - oxygen sag curve - dilution into sea, comparison of disposal methods.

Module 3 (10hrs)

Objectives of waste water treatment - Effluent standards, KSPCB Standards, BIS Standards. **Layout** of conventional treatment plant - preliminary, primary, secondary and tertiary treatments in general.

Screens - types of screens, design, disposal of' screenings; comminutors. **Grit chamber** - function, design, construction and operation, disposal of grit, detritus tank. **Skimming tank** -function, design and operation, disposal of skimmings **Sedimentation**: Theory of sewage sedimentation - design, construction and operation, rectangular and circular tanks, disposal of sludge.

Module 4 (15hrs)

Biological process: principle and theory of biological treatment**.** Sewage filtration: **Trickling filters** - design, construction and operation. **Activated sludge process**: Design, construction and operation of conventional and extended aeration, aeration methods. **Miscellaneous methods**- Stabilization ponds, Oxidation ditch, Aerated lagoons, rotating biological contactors; disinfection of sewage effluents.

Module 5 (15hrs)

Sludge treatment and disposal: quantity of sludge, characteristics of sludge, sludge thickening, digestion, conditioning and disposal, design of sludge digesters only. **Septic Tanks**: Design (as per Ministry of urban development) construction, disposal of effluents, cleaning of tanks, Imhoff tanks. Sewage treatment by **high rate anaerobic methods**: Anaerobic digestion, suspended growth, contact process, UASB, attached growth, filters, expanded bed - only basics.

References

1. Peavy, Rowe, Tchobanoglous, Environmental Engineering, Mc Graw Hill International Editions.
2. S. K. Garg, Environmental Engineering Vol. l & ll, Khanna Publishers, New Delhi.
3. B.C. Punmia, Water supply Engineering, Arihant Publications, Jodpur.
4. B.C. Punmia, Waste water Engineering, Arihant Publications, Jodpur.
5. Metcalf & Eddy, Waste water Engg.- Treatment and Reuse, 4th Edn., Mc Graw Hill International Editions.
6. Mark J Hammer, Water and waste water technology, John Wiley and sons, Inc.

CE010 804L01 ADVANCED FOUNDATION DESIGN (Elective III)

Teaching scheme: **Credit: 4**

2 hours lecture and 2 hours tutorial per week

Objective:

After acquiring the basic knowledge in soil mechanics and foundation engineering, this course is offered as an elective with the objective of giving in depth knowledge in the design of foundations for different structures and in difficult soils.

Module 1 (12 hrs)

Well foundations: Introduction- Applications-Different shapes of wells-grip length-scour depth-design depth-forces acting on well foundation-Terzaghi's method of analysis (only general case)-bearing capacity based on N value(only IS recommendation)-design of individual components of well-sinking of wells-measures for rectification of tilts and shifts. Features of Box(floating) caisson and pneumatic caisson

Module 2 (12 hrs)

Soil dynamics and Machine foundations: Introduction- Soil behavior under dynamic loads and application-Difference between static and dynamic load behavior-soil properties relevant for dynamic loading- free vibrations and forced vibrations- determination of dynamic soil constants in laboratory and field based on IS code provisions Types of machines-Types of machine foundations -vibration analysis of a machine foundation-general design criteria for machine foundations- Design criteria for foundation for reciprocating machines(only IS specifications) -vibration isolation and control

Module 3 (12 hrs)

Sheet Pile walls and Cofferdams: types and uses of sheet piles-design of cantilever sheet pile walls in granular and cohesive soils-anchored bulkhead-free earth support and fixed earth support method-coffer dams-uses- braced and cellular cofferdams

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Module 4 (12 hrs)

Special Foundations: Foundation for special structures such as water tanks, silos, cooling towers, guyed structures, ground storage tanks, chimneys, telecommunication towers, transmission line towers-foundation for under ground conduits- foundation for coastal and offshore structures-pre-stressed foundations. Shell Foundations-structural form and efficiency-different types.

Module 5 (12 hrs)

Foundations in Special soils: Foundation in expansive soil, soft and compressible soils, problems associated with foundation installation- ground water lowering and drainage- shoring and underpinning-different methods-damage and vibrations due to constructional operations

References

1. Bowles.J.E, Foundation Analysis and DesignMc Graw Hill Publishing Company.
2. N.P.Kurian, Modern foundations Tata Mc Graw Hill Publishing company
3. Srinivasulu P, Vaidyanathan C.V Handbook of Machine foundations
4. 11Teng W.C., *Foundation Design*, PHI
5 . P.C.Varghese, Foundation Engineering,Prentice-Hall of India Private Ltd, New Delhi
6 . Shashi K. Gulhati and Manoj Dutta, Geotechnical Engineering, Tata McGraw-Hill P ublishing Compay Limited,New Delhi.
7. Leonards G.A., *Foundation Engineering*, McGraw Hill
8 Arora K.R., *Soil Mechanics & Foundation Engg.,* Standard Publications
9 Punmia B. C., *Soil Mechanics & Foundations*, Laxmi Publications
10. Venkatramiah, *Geotechnical Engineering*, New Age International Publishers
11 Teng W.C., *Foundation Design*, PHI
12. Tomlinson M.J., *Foundation Design & Construction*, Pitman
13 .Coduto, *Geotechnical Engineering Principles and Practices*, Pearson Education

CE010 804L02 ENVIRONMENTAL GEOTECHNIQUES (Elective III)

Teaching scheme: **Credit: 4**

2 hours lecture and 2 hours tutorial per week

Objective:

Waste disposal is a major issue for which we need different effective and innovative methods. The objective is to familiarise the students, the different types of wastes generated , composition of the wastes, and the problems they pose on environment due to improper disposal. It also includes the different effective methods for the disposal for the different types of wastes.

Module 1 (12 hours)

Clay mineralogy and soil structure: Gravitational and surface forces-inter sheet and inter layer bonding in the clay minerals- Basic structural units of clay minerals- isomorphous substitution – kaolinite mineral- montmorillonite mineral -illite mineral- electric charges on clay minerals – base exchange capacity ,diffused double layer- adsorbed water- soil structure- methods for the identification of minerals (introduction only).

Module 2 (15 hours)

Effect of environment on Geotechnical properties of soils: Effect of drying on Atterberg limits.-Volume change behaviour- factors controlling resistance to volume change- general relationship between soil type, pressure and void ratio.- importance of mineralogical composition in soil expansion. Activity- sensitivity ,causes of sensitivity-Influence of exchangeable cations , pH and organic matter on properties of soils. Permeability of soils- hydraulic conductivity of different types of soils – Darcy' s law and its validity- factors affecting permeability

Module 3 (10hours)

Wastes and Contaminants (introduction only): sources of wastes-types of wastes composition of different wastes- characteristics and classification of hazardous wastes- generation rates- ground water contamination- sources of ground water contamination- transport mechanisms-potential problems in soils due to contaminants.

Module 4 (12 hours)

Disposal and containment technics: Criteria for selection of sites for waste disposal- hydrological aspects of selection of waste disposal sites- disposal facilities- subsurface disposal technics-disposal systems for typical wastes (sketches only)

Module 5 (12 hours)

Containment control systems-Liners and covers for waste disposal- rigid liners, flexible liners. Ground modification technics in waste management – waste modification- ground modification- mechanical modification-hydraulic modification- chemical modification.

References

1. Mitchell, J (1976), " Fundamentals of soil behaviour", John Wiley and sons, NewYork
2. Lambe, T. W & Whitman, R. V (1979), " Soil Mechanics ", John Wiley and Sons, New York.
3. Gopal Ranjan & A.S.R Rao (1991), " Basic and Applied Soil Mechanics, Wiley Eastern Ltd., New Delhi.
4. Wilson, M. J (1987), " A Hand book of Determinative methods in Clay Mineralogy", Chapman and Hall, New York.
5. Robert M. Koerner (1984), "Construction and Geotechnical methods in Foundation Engineering", McGraw Hill Book Co., New York.

CE010 804L03 EARTHQUAKE ENGINEERING AND DESIGN (Elective III)

Teaching scheme: **Credit: 4**
2 hours lecture and 2 hours tutorial per week

Objective: *To have a general awareness about effects of earthquake and study of seismic design of structures.*

Module 1 (9 hrs)
Causes of Earthquakes: The earth and its interior, the circulations, plate tectonics. Types of earthquakes.
Seismic waves, measuring instruments, locating focus of earthquakes from wave velocity strong ground motions, characteristics of strong ground motion, magnitude, intensity and energy release. Direct and indirect effects of earthquake.

Module 2 (8 hrs)
Past earthquakes in India, basic geography and tectonic features of India, seismic zones of India.
Inertia forces in structures, flow of inertia, forces to foundations, effect of deformation in structures.
Building forms for earthquake resistance, Architectural features, size of buildings, horizontal and vertical layout of buildings.

Module 3 (14 hrs)

Torsion in buildings, Rigid and flexible floor diaphragm, Torsionally coupled and uncoupled system, earth design philosophy. importance of ductility, capacity design concept-Strong column weak beam concept, weak storey, flexibility of long and short period structures.

Module 4 (16 hrs)

Equivalent static lateral earthquake force analysis based on IS: 1893-2002, capacity design and detailing of R.C. building.
Flexible and rigid floors. Role of shear wall, load distribution among shear walls.

Module 5 (13 hrs)

Behaviour of brick masonary walls, Box action of masonary buildings, role of horizontal and vertical bands, retrofitting techniques of R.C.C. and masonry Buildings.

References
1. Earthquake resistant design of structures, P. Agarwal and. **M.**Shrikande, PHI Learning Pvt. Ltd., New Delhi
2. Earthquake resistant Design of structures, S.K. Duggal, Oxford University Press, New Delhi

3. Geo technical Earthquake Engineering, S. L. Kramer, Pearson Education.
4. Earthquake Tips, C. V. R. Murthy, BMTPC, New Delhi
5. Bureau of Indian Standards
   I S: 1893(Part I 2002)
   I S: 113920-1993
   I S: 13935-1993
   I S: 13828 -1993
6. Earthquakes, Bruce A. Bolt, W. H. Freeman & Company
7. Basic Geotechnical Earthquake Engineering. Dr.Kamalesh Kumar, New age International Pvt. Ltd.l

CE 010 804L04 ADVANCED HYDROLOGY AND SYSTEM ANALYSIS
(Elective -III)

Teaching scheme: **Credit: 4**

2 hours lecture and 2 hours tutorial per week

Objective: *To increase knowledge on the application of advanced hydrologic methods to water resources problems. Hydrologic analysis emphasizes computational methods in hydrology for specific tasks. The level of understanding should, upon completion of the course, be sufficient to understand and appreciate the important issues in the current literature where statistical and optimization methods are used in prediction and interpretation of hydrologic processes.*

Module 1 (10hrs)

Introduction: Hydrologic cycle- Weather and hydrology: Thermal circulation - effects of earth's rotation - effect of' land and water distribution - migratory systems - fronts - measurement of temperatures –- geographic distribution of temperatures - time variations of temperatures - properties of water vapour- Measurement of humidity – geographic distributions of humidity - time variations in humidity-geographic variations of wind - time variations of wind - scanning and predicting weather.

Module 2 (10 hrs)

Precipitation: Measurement of precipitation- recording gauges - automatic gauges radars - estimation of missing data and adjustment of records - mean areal depth of precipitation - rain gauge network- design principles-depth area duration curves – Hyetograph, hydrograph and mass curve of rainfall - analysis of rainfall data - moving average curves - design storms – probable maximum precipitation curves snowfall and measurement. Determination of snow melts. Water Losses: Evaporation-evaporation pans – evapometre, control of' reservoir evaporation - soil evaporation - transpiration - estimation of evapo transpiration - infiltration - infiltration curves - determination of infiltration indices - water shed leakage - water balance.

Module 3 (10 hrs)

Runoff: Catchments characteristics - classification of streams- run off estimation by empirical formulae, curves, infiltration method, rational method, overland flow hydrograph and unit hydrograph method.

Hydrographs**:** Separation of stream, flow components - - unit hydrograph - assumption - derivations of unit hydrograph - unit hydrograph of complex storms - instantaneous unit hydrograph - synthetic unit hydrograph-applications.

Module 4 (15hrs)

Floods: Definition of standard project flood –Frequency analysis- maximum probable flood – probable maximum precipitation and design flood - estimation of peak flood-flood control. Measures - flood forecasting techniques- flood routing - analytical and graphical methods of flood routing. The erosion process - factors controlling erosion - reservoir sedimentation - control of reservoir sedimentation.

Module 5 (12 hrs)

System analysis: Basic system analysis concepts, scope and steps in system engineering-system approach-need for system approach-concept of models-classification of models-General system model, Descriptive vs Predictive, Single vs Multiple events and Stochastic vs Deterministic Models-simulation models- applications

Probability analysis of hydrological data**:** mean, median, mode, mean-deviation, standard deviation, variances and skewness of data normal, gamma, poisons, log normal and pears and type III distributions - flood, frequency by fuller's, Gumbel's, Powel and Ven Te chow methods.

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References

1. H. M.Reghunath, Hydrology, Wiley Easten Ltd., New Delhi.
2. Santhosh Kumar Garg, Hydrology and flood control engineering, Khanna Publishers.
3. R.K. Linsley, M. A. Kholar, Hydrology for engineers, Tata Mc Graw Hill.
4. Ven Te Chow, Maidment, D. R., and Mays, L. W., Applied Hydrology, McGraw-Hill, 1988.
5. Vijay P. Singh, Elementary Hydrology, Prentice Hall, 1992.
6. Viessman and lewis, introduction to hydrology, Harper Collin college publisher, 1996
7. Nathabandu T. Kottegoda and Renzo Rosso, Statistics, Probability, and Reliability for Civil and Environmental Engineers, The McGraw-Hill Companies, Inc., 1997.
8. Alfredo H.S. Ang and Wilson H. Tang, Probability Concepts in Engineering Planning and Design Vol. I Basic Principles and Vol. II Decision, Risks and Reliability, Wiley, 1975.
9. D.R. Helsel and R.M. Hirsch, Statistical Methods in Water Resources, USGS, 2002, http://pubs.usgs.gov/twri/twri4a3/.
10. C. T. Hann, Statistical Methods in Hydrology, The Iowa State University Press, 1977.
11. George P. Box and Gwilym M. Jenkins, Time Series Analysis: Forecasting and Control, Holden Day, 1976.

CEO10 804L05 HIGHWAY AND AIRFIELD PAVEMENTS (Elective III)

Teaching scheme: **Credit: 4**
2 hours lecture and 2 hours tutorial per week

Objective:
To equip the students to carry out design and evaluation of flexible and rigid pavements in varied field conditions.

Module 1 (12hrs)
Pavement types: stress distribution in pavements - theoretical subgrade conditions and traffic loadings Basic difference between flexible and rigid pavements - design factors - wheel load - equivalent single wheel load - repetition of loads - elastic modulii - climatic variations.

Module 2 (12hrs)
Design of flexible pavements: group index method - CBR method - IRC recommendations - Me Load method - Burmister's layer theory.

Module 3 (12hrs)
Design of rigid pavements: radius of relative stiffness - critical load positions - Westergaard's stress equation - Bradley's stress coefficients - design charts.

Module 4 (12hrs)
Temperature stresses in concrete pavements: Westergaard's concept - wrapping stress - functional stress - combination of stresses.
Design of joints in concrete pavements: expansion joints - construction joints - design of dowel bars - tie bars - IRC recommendation.

Module 5 (12hrs)
Evaluation of pavement condition: pavement instrumentation - types of pavement distress - roughness and skid resistance. Environmental influence and effects-pavements maintenance and overlays.

References
1. Bindra B.S, Highway Engineering, Danpat Rai and Sons.
2. H.J.Yoder, Principles of Pavement Design, John wiley and sons
3. Khanna O.P, Justo C.G., Highway Engineering, Nem Chand Publishers
4. IRC Standard specifications for Construction of Flexible and rigid pavements

CE010 804 L06 STRUCTURAL DYNAMICS AND STABILITY ANALYSIS

(Elective III)

Teaching scheme: **Credit: 4**

2 hours lecture and 2 hours tutorial per week

Objective:

To study 1. the basic concepts of stability.

2.the comprehensive methods of dynamic analysis.

Module 1 (12 hours)

Introduction-problems in nature-steady state problem-dynamic problem-stability problem (Eigen value problem)-introduction to dynamic loading-D'Alembert' s equation of equilibrium-inertia force-effect of damping-Hamilton' s principle.

Module 2 (12 hours)

Single degree of freedom system-idealisation-free vibration-natural frequencyresonance-forced vibration-lumped mass-consistent mass.

solution techniques-determinant search procedure-Householders method

Module 3 (12 hours)

Introduction to stability analysis-energy principles-stable, unstable and neutral equilibrium-fourth order differential equation for generalized bending problemselastic instability of columns-Euler' s theory-assumptions-limitations. General treatment of column stability problem as an Eigen value problem-various modes of failure for various end conditions- both ends hinged-both ends fixed-one end fixed other end free- one end fixed other end hinged

Module 4 (13 hours)

Beam column-beam column equation-solution of differential equation for various lateral loads-udl and concentrated loads-solutions for various end conditions-both ends hinged-both ends fixed-one end fixed other end free- one end fixed other end hinged.

Module 5 (11 hours)

Finite element application to dynamics-element stiffness matrix and mass matrix of a beam element. Finite element application to stability analysis- finite element stability analysis-element stiffness matrix –geometric stiffness matrix-derivation of element stiffness matrix and geometric stiffness matrix for a beam element.

References

1. Ray W Clough, Joseph Penzien, Dynamics of structures, Mc Graw Hill,Kogabusha Ltd.
2. Ziegler H, Principles of structural stability, Blarsdell, Wallham, Mass, 1963.
3. Thompson J M, G W Hunt, General stability of elastic stability, Wiley, NewYork.
4. Timoshenko, Gere, Theory of elastic stability, Mc Graw Hill, New York.
5. Don O Brush, B O O Almorth, Buckling of Bars, plates and shells,
6. Cox H L, The buckling of plates and shells, Macmillam, New York, 1963.
7. O C Zienkiewicz ,.Finite Element Method ,fourth Edition,McGraw Hill,
8. R.D.Cook, Concepts and Applications of Finite Element Analysis, John Wiley&Sons.

CE010 805G01 FINITE ELEMENT ANALYSIS (Elective IV)

Teaching scheme: **Credit: 4**
2 hours lecture and 2 hours tutorial per week

Objective:
To make the back ground, basic concepts and basic formulation of finite element method

Module I (12hrs)
Introduction to FEM-Historical development-Idealization of actual structures-Mathematical model-General procedure of FEA-Displacement approach. Solution techniques- Gauss Elimination – Frontal solver (concepts only)

Module 2 (12hrs)
Finite element analysis- -Energy principles- Principle of Stationary Potential Energy- Complementary Energy - Variational approach -Stable- Unstable-Neutral equilibrium-Virtual work- Principle of virtual forces – Principle of virtual displacements.

Module 3 (12hrs)
Shape functions-Lagrangian and Hermition Interpolation – Polynomials – General coordinates-Area coordinates-Compatibility –C_0 and C_1 elements-convergence criteria- conforming & nonconforming elements – Patch test

Module 4 (12hrs)
Stiffness matrix-Bar element-Beam element-Triangular elements - Constant Strain Triangle-Linear Strain Triangle- Isoparametric elements-Numerical Integration - Gauss Quadrature.

Module 5 (12hrs)
General plate bending elements- Plate bending theory – Kirchhoff's theory – Mindlin's theory – Introduction to locking problems- preventive measures – reduced integration – selective integration. Axysymmetric elements- Introduction to shell elements

References

1. O C Zienkiewicz,.Finite Element Method, fourth Edition,McGraw Hill,
2. R.D.Cook, Concepts and Applications of Finite Element Analysis, John Wiley &Sons.
3. Stephen P.Timoshenko& Krieger, S.W., Theory of Plates and Shells, McGraw Hill.
4. C.S.Krishnamoorthy, Finite Element Analysis, Tata McGraw Hill .New Delhi, 1987.
5. S.Rajasekharan, Finite Element Analysis, Wheeler Publishing Co., &Sons.1993.
6. T.Kant, Finite Element Methods in Computational Mechanics, Pergamons Press.
7. K.J.Bathe, Finite Element Procedures in Engineering Analysis, Prentice Hall,
8. Mukhopadhyay M., Matrix Finite Element Computer and Structural Analysis,

Oxford &IBH, 1984.
9. Irving H.Shames, Energy &Finite Element Methods in Structural Mechanics.
10. Desai C.S.&Abel J.F., Introduction to Finite Element Methods, East West Press

CE010 805G02 ENVIRONMENTAL POLLUTION CONTROL TECHNIQUES (ELECTIVE IV)

Teaching scheme: **Credit: 4**

2 hours lecture and 2 hours tutorial per week

Objective:

- *To understand the basic concept of various forms of Environmental Pollution*
- *To develop knowledge in control techniques for Environmental Pollution*

Module 1 (12hrs)

Introduction to environmental pollution

Air pollution – Sources – Criteria pollutants – Control of gaseous pollutants (adsorption, absorption, reaction and other methods) – Control of particulate pollutants (settling chambers, cyclone separation, Wet collectors, fabric filters, electrostatic precipitators)– Automobile pollution control

Module 2 (12hrs)

Water pollution – Sources – Various Pollutants – Treatment and control methods – Physico-chemical and Biological Treatments – Screening, skimming, sedimentation, coagulation, Filtration, Trickling Filters, Activated sludge process, Oxidation ponds, high rate anaerobic methods (design not needed)

Module 3 (12hrs)

Industrial Pollution - Characteristics of industrial wastes**:** physical, chemical and biological. Pretreatment of industrial wastes**:** waste volume reduction, waste strength reduction - neutralization, equalization and proportioning.

Theories of treatments processes**:** sedimentation flotation coagulation - evaporation & ion exchange – lagooning - activated sludge treatment - High rate anaerobic treatment.

Module 4 (12hrs)

Solid waste management: Type and source of solid waste, characteristics, collection, transportation and processing- Waste minimization strategies – Reduction - Recycling – Reuse – Disposal - composting, sanitary landfill, incineration, .

Module 5 (12hrs)

Noise pollution: Sources, effects of noise pollution, control measures.

Administrative and Legislative control of environmental pollution. Important Environmental rules and regulations, environmental protection laws and acts.

References

1. Peavy, Rowe, Tchobanoglous, Environmental Engineering, Mc Graw Hill International Editions.
2. M.N. Rao & H.V.N. Rao, Air Pollution, Tata Mc Graw Hill Pvt. Ltd., New Delhi.
3. S. K. Garg, Environmental Engineering Vol. l & ll, Khanna Publishers, New Delhi.
4. B.C. Punmia, Water supply Engineering, Arihant Publications, Jodpur.
5. B.C. Punmia, Waste water Engineering, Arihant Publications, Jodpur.
6. Nelson Leonard Nemerow, Theories and practices of industrial waste treatment, Addison-Wesley Publishing Co., Inc.

7. W Wesley Eckenfelder Jr., Industrial water pollution control, International Edition, Mc Graw Hill Inc, New Delhi.
8. M Narayana Rao, Waste water treatment, Rational methods of design and Industrial practice, Oxford & IBH Publishing Co. Pvt. Ltd, Bombay.
9. C.S. Rao, Environmental Pollution Control Engineering, New Age International (P)Ltd, New Delhi.
10. Warren Viessman and mark J Hammer, Water Supply and Pollution Control, Pearson Education, Inc.
11. Gilbert M.Masters, Kurian Joseph and R. Nagendran, Introduction to Environmental Engineering and Science.
12. Ruth F. Weiner and Robin Matthews, Environmental Engineering, Butterworth-Heinemann, Elsevier.

CE010 805G03 OPTIMIZATION TECHNIQUES (Elective IV)

Teaching scheme: **Credit: 4**

2 hours lecture and 2 hours tutorial per week

Objective:

To make the students aware of scientific methods and techniques to decision making problems and provides the best optimal solutions.

Module 1 (12hrs)
Classical optimization techniques
Single variable optimization – Multivariable optimization with no constraints – Hessian matrix – Multivariable saddle point – Optimization with equality constraints – Lagrange multiplier method - Multivariable optimization with inequality constraints – Kuhn-Tucker conditions.

Module 2 (12hrs)
One-dimensional unconstrained minimization
Elimination methods – unrestricted search method – Fibonacci method – Interpolation methods – Quadratic interpolation and cubic interpolation methods.

Module 3 (12hrs)
Unconstrained minimization
Gradient of a function – Steepest descent method – Newton's method – Powells method – Hooke and Jeeve's method.

Module 4 (12hrs)
Integer – Linear programming problem
Gomory' s cutting plane method – Gomory' s method for all integer programming problems, mixed integer programming problems**.**

Module 5 (12hrs)
Network Techniques
Shortest path model – Dijkstra`s Algorithm – Floyd`s Algorithm – minimum spanning tree problem – PRIM algorithm – Maximal Flow Problem algorithm.

References

1. S.S. Rao, Optimization theory and application, New Age International P. Ltd.
2. A.D. Belegundu, T.R. Chandrupatla, Optimization Concepts and applications in Engineering, Pearson Education Asia.
3. F. S. Budnick, D. McLeavey, R. Mojena, Richard D, Principles of Operations Research for Management, Irwin, INC.
4. H. A. Taha, Operation Research an introduction, Eastern Economy Edition.
5. R. Panneerselvam, Operations Research, PHI.

CE010 805G04 LAND USE PLANNING (Elective IV)

Teaching scheme: **Credit: 4**

2 hours lecture and 2 hours tutorial per week

Objectives:

The basic objective of this course is to introduce to the students of planning the various theories of planning and city design along with necessary details in terms of population projection, formulation of activity structure, formulation of goals and objectives for any planning work to be carried out. This course is also aimed at students getting enough theoretical background to carry concurrent laboratory exercise in area planning and city planning. Attempt has been made to include several case studies and relate them to the theories of planning to develop better understanding of urban planning.

Module 1 (10 Hrs)

Introduction: Brief Study of Urban Travel Patterns and Urban Transportation Technologies; Land use-Transportation Planning Process

Module 2 (13 Hrs)

Urban Forms and Urban Structure: Hierarchy of Urban Activity System, Hierarchy of Urban Transportation Network and Technology; Relationship between Movement and Accessibility Functions of Transportation Network; Urban Structure and its Characteristics such as Centripetal, Grid Iron, Linear and Directional Grid types, Study of Urban Forms such as Garden City, Precincts, Neighbourhoods, Linear City, MARS Plan, LeCorbusier Concept, Radburn Concept, Environmental Area Concept.

Module 3 (13 Hrs)

Demographic and Employment Forecasting Models: Demographic Models- Linear, Exponential and Logistic Models,; Cohort Survival Models-Birth, Aging and Migration Models; Employment Forecasting Models- Economic base Mechanism; Population and Employment Multiplier Models- Input and Output Models - Dynamic Models of Population and Employment

Module 4 (12 Hrs)

Land use-Transportation Models: Lowry based Land use-Transportation Models – Allocation Function, Constraints, Travel Demand Estimation – Iterative Solutions, Matrix Formulation

Module 5 (12 Hrs)

Evaluation of Land use – Transportation Plans: Operational, Environmental and Economic Evaluation – Concept of Demand and Supply for Transportation Projects – Benefit and Cost – B/C and Cost Effective Approach for Economic Evaluation.

References

1) Hutchinson B.G., Principle of Transportation Systems Planning, McGraw-Hill.
2) Oppenheim N., Applied Models in Urban and Regional Analysis, Prentice-Hall.
3) Dickey J.W., *et. al*., Metropolitan Transportation Planning, Tata McGraw-Hill.
4) Gallion A.B and Eisner S., The Urban Pattern, Affluated East-West Press, New Delhi.
5) Heggei, I.G., Transportation Engineering Economics, Mc-Graw Hill Book Company, New York.
6) Wilson, A.G, Urban and Regional Models in Geography and Planning, John Wiley and Sons.

CE 010 805G05 NUMERICAL METHODS (Elective IV)

Teaching scheme: **Credit: 4**

2 hours lecture and 2 hours tutorial per week

Objective

To impart the basic concepts of mathematical modeling of problems in science and engineering and to know procedures for solving different kinds of problems.

To understand the various numerical techniques which provide solutions to non linear equations, partial differential equations etc that describe the mathematical models of problems.

Module I (10 hours)

Solution of linear equations:- Review of Gaussian elimination and Cholesky methods- storage schemes – substructure concept- sub matrix equation solver

Module 2 (12 hours)

Solution technique for Eigen value problem:- Introduction – forward iteration, inverse iteration, Jacobi's method

Module 3 (13 hours)

Numerical Interpolation& Integration – Introduction – Lagrange, Hermitian and isoparametric style of interpolation. Numerical integration - trapezoidal rule - Simpson 1/3 rule - Simpson 3/8 rule - Gauss quadrature formula – weights and Gauss points

Module 4 (12 hours)

Finite difference techniques:-Finite difference method, ,Newton's method, Variational and weighted residual methods

Module 5 (13 hours)

Statistical Computations - frequency Chart - method of least square curve fitting procedures - fitting a straight line - curve fitting by sum of exponential - data fitting with cubic splines - approximation of functions. Regression Analysis - linear regression

References

1. Balagurusamy E , *Numerical Methods*, Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 1999.
2. Gerald C.F. and Wheatley P.O., *Applied Numerical Analysis, 6th Ed.*, Pearson Education Asia, New Delhi, 2002.
3. Rajasekharan S, Numerical Methods in Science and Engineering, A practical Approach, A.H. Wheeler &Co
4. K.J. Bathe, Finite Element Procedures in Engineering Analysis, Prentice Hall,
5. Jain M.K., Iyengar S.R.K. &Jain R.K, Numerical Methods for Science and Engineering, Prentice Hall of India
6. Saumyen Guha& Rajesh Srivastava, Numerical Methods for Engineering and Science, Oxford University Press.

CE010 805G06 REMOTE SENSING AND GIS APPLICATIONS (Elective IV)

Teaching scheme **Credit: 4**

2 hours lecture and 2 hours tutorial per week.

Objective

To make the students aware of the technological developments in the geographical database management and its advantages.

Module 1 (13hours)

Remote sensing: definition- components of remote sensing- energy sensor, interacting body- active and passive remote sensing- platforms- Arial and space platforms- balloons, helicopters, aircrafts and satellites- electromagnetic radiation(EMR)- EMR spectrum- visible, infrared(IR) ,near IR, middle IR, thermal IR and microwave- black body radiation- Plancks Law- Stefan-Boltzman law.

Module 2 (12hours)

Atmospheric characteristics- scattering of EMR- Raliegh, Mie, Non-selective and Raman scattering- EMR interaction with water vapour and ozone- atmospheric windows- significance of atmospheric windows- EMR interaction with earth surface material, radiance, irradiance, incident, reflected, absorbed and transmitted energy- reflectance- specular and diffused reflection surfaces- spectral signature- spectral signature curves- EMR interaction with water, soil and earth surface.

Module 3 (12hours)

Optical and Microwave Remote sensing:

Satellites- classification- based on orbits- sun synchronous and geo synchronous- based on purpose- earth resources satellites, communication satellites, weather satellites, spy satellites- satellite sensors- resolution- spectral, spatial, radiometric and temporal resolution- description of multi-spectral scanning- along and across track scanners- description of sensors in IRS series- current satellites- radar- speckle- back scattering- side looking air borne radar- synthetic aperture radar- radiometer radar- geometrical characteristics. Principles of thermal remote sensing- Principles of microwave remote sensing.

Module 4 (12hours)

Geographic information system- components of GIS- hardware, software and organizational context- data- spatial and non spatial maps- types of maps- projection- types of projection- data input- digitizer, scanner, editing- raster and vector data structures- comparison of raster and vector data structure- analysis using raster and vector data- retrieval, reclassification, overlaying, buffering- data output- printers and plotters.

Module 5 (12hours)

Miscellaneous topics: interpretation of satellite images- elements of interpretation- visual interpretation- digital image processing techniques- image enhancement- filtering- image classification- FCC composites- supervised and unsupervised integration of GIS and remote sensing- application of remote sensing and GIS- urban applications- water resources- urban analysis- watershed management- resources information system- hazard mitigation.

References:

1. Thomas M.Lillesand &Raiph W.Kiefer,"remote sensing and image interpretation",John Wiley Sons.
2. Floyd F. Sabins, "Remote sensing principles and interpretation", Freeman And Company.
3. Anji Reddy,"Remote sensing and geographical systems",BS Publications.
4. M.G.Srinivas (Edited by),"Remote Sensing Applications", Nerusa publications.
5. Jensan J.R.,"Introductory Digital Image Processing",Prentice Hall of India.

CE010 806 ENVIRONMENTAL ENGINEERING LAB

Teaching scheme **Credits: 2**

3 hours practical per week

Objective:

To make students familiar with laboratory tests for water and waste water quality assessment.

List of Experiments

1. Determination of alkalinity of water.
2. Determination of hardness of water.
3. Determination of acidity of water.
4. Determination of iron.
5. Determination of sulphates.
6. Determination of Chlorine demand and residual chlorine.
7. Determination of chlorides in water.
8. M. P. N. of Fecal coliforms using A-l medium
9. D.O. and Biochemical Oxygen Demand.
10. Chemical oxygen demand.
11. Determination of solids - total, suspended, dissolved, fixed, volatile, settleable and SVI.
12. Determination of Turbidity and estimation of optimum coagulant dosage by jar test.
13. Determination of pH

Reference:

1. "Standard methods for the examination of water and wastewater" 1995, ALPHA, AWWA, WPCF Publication.
2. "Chemistry for Environmental Engineering"- Sawer and McCarty, McGraw Hill.
3. "Manual of standards of quality for Drinking Water Supplies"- Indian Council of Medical Research, New Delhi.
4. "International Standards of Drinking Water" – W.H.O.
5. "IS 2490-1981, IS 3306- 1974, IS 3307-1977, IS 7968-1976, IS 2296-1974, IS 10500-1991" Bureau of Indian Standards, New Delhi, Effluent Standard KSPCB.

CE010 807 Project Work

Teaching scheme **credits: 4**

6 hours practical per week

The progress in the project work is to be presented by the middle of eighth semester before the evaluation committee. By this time, the students will be in a position to publish a paper in international/ national journals/conferences. The EC can accept, accept with modification, and request a resubmission.

The progress of project work is found unsatisfactory by the EC during the middle of the eighth semester presentation, such students has to present again to the EC at the end of the semester and if it is also found unsatisfactory an extension of the project work can be given to the students.

Project report: To be prepared in proper format decided by the concerned department. The report shall record all aspects of the work, highlighting all the problems faced and the approach/method employed to solve such problems. Members of a project group shall prepare and submit **separate** reports. Report of each member shall give details of the work carried out by him/her, and only summarise other members' work.

The student's sessional marks for project will be out of 100, in which 60 marks will be based on day to day performance assessed by the guide. Balance 40 marks will be awarded based on the presentation of the project by the students before an evaluation committee.

For Project, the minimum for a pass shall be 50% of the total marks assigned to the Project work.

CE010 808 Viva -Voce

Teaching scheme **credits: 2**

A comprehensive oral Viva-voce examination will be conducted to assess the student's intellectual achievement, depth of understanding in the specified field of engineering and papers published / accepted for publication etc. At the time of viva-voce, certified bound reports of seminar and project work are to be presented for evaluation. The certified bound report(s) of educational tour/industrial training/ industrial visit shall also be brought during the final Viva-Voce.

An internal and external examiner is appointed by the University for the Conduct of viva voce University examination.

For Viva-voce, the minimum for a pass shall be 50% of the total marks assigned to the Viva-voce.

Note: If a candidate has passed all examinations of B.Tech. course (at the time of publication of results of eighth semester) except Viva-Voce in the eighth semester, a re-examination for the Viva-Voce should be conducted within one month after the publication of results. Each candidate should apply for this 'Save a Semester examination' within one week after the publication of eighth semester results.