UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VIII SEMESTER

CIVIL ENGINEERING

SCHEME -2013

VIII SEMESTER

CIVIL ENGINEERING (C)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.801	Quantity Surveying and Valuation (C)	4	3	1	-	50	3	100	150
13.802	Design and Drawing of Steel Structures (C)	5	3	-	2	50	4	150	200
13.803	Urban Planning and Architecture (C)	4	4	-	-	50	3	100	150
13.804	Construction Management (C)	3	3	-	-	50	3	100	150
13.805	Elective - III	4	3	1	-	50	3	100	150
13.806	Elective - IV	4	3	1	-	50	3	100	150
13.807	Project and Viva-Voce (C)	5	-	-	5	200		100	300
	Total	**29**	**19**	**3**	**7**	**500**		**750**	**1250**

ELECTIVE -III

13.805.1	Earthquake Resistant Design of Structures (C)
13.805.2	Wind Loading on Structures (C)
13.805.3	Deep Foundations (C)
13.805.4	Earthquake Geotechnical Engineering (C)
13.805.5	Urban Water Management and Environmental Hydraulics (C)
13.805.6	Environmental Impact Assessment (C)
13.805.7	Design and Construction of pavements (C)
13.805.8	Repair & Rehabilitation of Structures (C)

ELECTIVE -IV

13.806.1	Finite Element Methods (C)
13.806.2	Design of Bridges (C)
13.806.3	Reinforced Earth (C)
13.806.4	Advanced Foundation Engineering (C)
13.806.5	Irrigation and Drainage Engineering (C)
13.806.6	Industrial Waste Water Management (C)
13.806.7	Traffic Engineering (C)
13.806.8	Valuation of Real Properties (C)
13.806.9	Design of Port, Harbour and Coastal Structures (C)

13.801 QUANTITY SURVEYING AND VALUATION (C)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *To get concepts and ideas in quantity surveying with respect to the estimation of any construction and to understand the basis of valuation of any building or construction.*
- *To develop skill in preparing detailed estimate using Data book and Schedule of rates.*

Module – I

General Introduction:- Specifications- purposes and basic principles-general specifications. Analysis of rates- Introduction to the use of data book and schedule of rates- cost of materials at site- cost of materials at source- conveyance charges. Detailed specification, preparation of data and analysis of rates for various items of work connected with building construction and culverts with reference to Indian Standard Specification.

Module – II

Quantity Surveying- Basic principles-Types of Estimate- Detailed estimate including quantities, abstract and schedule of rates of various items of works- residential buildings, office/ school building, Sanitary and water supply works- Soak pits, Septic tanks, Culverts, Retaining walls.

Module – III

Bar-bending schedule-preparation of bar-bending schedule for RCC works connected with building construction (beam, slabs, columns, footing), Culverts, Retaining walls and minor irrigation works.

Module – IV

Valuation- Principles of valuation of old buildings and apartment structure- Methods of valuation: Depreciation- current rates of depreciation and net values. Fixation of rent - Gross and net rent - methods.

References:

1. Dutta B. N., *Estimating and Costing in Civil Engineering*, USB Publishers and Distributers Ltd, New Delhi
2. Chakrabarti M., *Estimating and Costing in Civil Engineering*, USB Publishers and Distributers Ltd, New Delhi

3. Vazirani V. N. and S. P. Chandola, *Civil Engineering Estimating and Costing*, Khanna Publishers.
4. Rangwala S. C., *Elements of Estimating*, Charotar Publishing House.
5. IS 1200-1968, *Methods of Measurement of Building & Civil Engineering Works.*
6. Banerjee D.N., '*Parks Valuation*'-5th Edition, Eastern Law House, Calcutta, 1998.
7. George E. Deathrage, Construction Schedule & Control, McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, drawings, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question from Module I and Module IV carries 15 marks. Each question from Module II and Module III carries 25 marks.

***Note:** For analysis of rate and cost estimation, unit rate and labour requirement should be given along with the questions by the question paper setter. No other charts, tables, codes are permitted in the Examination Hall. If necessary, relevant data shall be given along with the question paper by the question paper setter.*

Course Outcome:

The students after undergoing this course will have the capability to prepare detailed estimate of various construction works and to present valuation report of buildings.

13.802 DESIGN AND DRAWING OF STEEL STRUCTURES (C)

Teaching Scheme: 3(L) - 0(T) - 2(D) **Credits**: 5

Course Objectives:

- *To introduce the various design philosophies applicable to some special structures.*
- *To apply the knowledge structural analysis and design in the design of complete structure.*
- *To communicate the design details by preparing drawings.*

Module – I

Water tanks- Design of rectangular steel tanks- Pressed steel tanks- Cylindrical tanks with hemispherical bottom- Design of supporting towers and its foundation.

Roofs -Design of purlins and trusses for dead load, live load and wind loads - rolled steel angle and tubular sections.

Drawings of the structures designed above.

Module – II

Steel chimneys-Types of chimneys, IS Specifications-Design of self supporting chimneys.

Steel bridges –Types of bridges, Railway modified BG and modified MG loading -Design of plate girder bridges - Truss girder bridges (only design concept) -bracings and bearings.

Drawings of the structures designed above.

References:

1. Raghupathy, *Design of Steel Structures*, Tata McGraw Hill, 1995.
2. Ramachandra, *Design of Steel Structures*, Standard books, 2011.
3. Arya A. S. and J. L. Ajmani, *Design of Steel Structures*, Nemchand & Bros, 1996.
4. Ramamrutham S., *Design of Steel and Timber Structures*, Dhanapath Rai, 1986.
5. Vazirani V. N. and M. M. Ratwani, *Steel Structures and Timber Structures*, Khanna Publishers, 1994.
6. IS. Codes 800-2007, 875 (2&3)-1987,6533-1989,1161-1979, 804-1958, 806-1968
7. *Railway Loading Standards (Bridge Rules),* Ministry of Railways, Govt. of India, 2008.
8. Dayarathnam P., *Design of Steel structures*, Wheeler Publishers, 2007.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, preparation of structural drawings

20% - Regularity in the class

University Examination Pattern:

Examination duration: 4 hours *Maximum Total Marks: 150*

The question paper shall consist of 2 parts.

Part A (40 marks) - From Module I and Module II. Two questions of 20 marks each. All questions are compulsory. There should be one question from each module.

Part B (110 Marks) - Candidates have to answer one full question out of the two from each module. The question consists of design and drawing part. Each question carries 55 marks (30 marks for design and 25 marks for drawing).

***Note:** Use of IS. Codes 800-2007, 875 (2&3)-1987, 6533-1989 and Railway loading standards are permitted in the examination hall.*

Course Outcome:

The students after undergoing this course will have

- *Capability to design complete structure after performing required analysis for intended loading.*
- *Ability to prepare detailing drawing required for the trouble-free execution of the structures.*

13.803 URBAN PLANNING AND ARCHITECTURE (C)

Teaching Scheme: 4(L) - 0(T) - 0(P) **Credits**: 4

Course Objectives:

- *To develop awareness of creative principles and styles of architecture.*
- *To develop a basic knowledge in urban development and planning.*
- *To develop awareness of the sustainability dimensions of architecture and urban development.*

Module – I

Architecture: definition–factors influencing architectural development. Principles of architecture: Contrast, proportion, scale, balance, rhythm, character, colour and unity. Indian architecture: A brief study of the architecture of Buddhist, Hindu and Indo- Islamic period. Kerala architecture: Traditional temple and domestic architecture of Kerala. Contributions of some of the renowned architects: Contributions of Laurie Baker to Kerala architecture, Contributions of Le Corbusier and Frank Lloyd Wright to modern architectural philosophy.

Module – II

Basics of planning: Evolution of towns – problems of urban growth – demography - rural – urban migration – beginning of town planning acts – ideal towns – garden city movement – concept of new towns and conservative surgery - comprehensive planning of towns. Basics of town planning surveys – Land use surveys and analysis – Socio-economic surveys. Development plans – Regional planning – Zoning and subdivision regulation – FSI/FAR – Neighbourhood planning – planning principles – site planning – site selection criteria for housing development – types – site analysis.

Module – III

Basic concepts of sustainable habitat – goals for sustainable development – global initiatives for sustainable development – resource based planning – urban infrastructure planning in sustainability context – urban growth and sustainability of water resources – socio-economic development and sustainable planning – sustainable new towns.

Module – IV

Introduction to the concept and issues of Sustainable Architecture – basic concepts of Green Buildings – energy efficiency in buildings(brief description only) – resource conservation and sustainable construction – various rating systems for the assessment of sustainability - Indian systems TERI GRIHA, LEED India rating – Sustainable building practices in India.

References

1. Ernest Pickering, *Architectural Design*, John Wiley & Sons.
2. Hiraskar G. K., *The Great Ages of World Architecture*, Dhanpat Rai Publications, New Delhi, 2003.
3. Banister Fletcher, *A History of Architecture*, Taraporevala.
4. Percy Brown, *Indian Architecture – Buddhist and Hindu Periods*, Hardcover.
5. Percy Brown, *Indian Architecture _ Islamic Period*, Taraporevala.
6. Prabhu B. T. S., A. Achyuthan, *Vastuvidyapravesika A Text Book of Vastuvidya*, Vastuvidya Pratisthanam, Calicut.
7. Arthur B. Gallion, *Urban Pattern*, D. Van Nostrand CD. Inc.
8. Pelic Hall, *Urban and Regional Planning*, Routledge, London and New York, 2002.
9. Lewis Keeble, *Principles and Practices of Town Planning*, Estates Gazette, London
10. Ramachandran R., *Urbanization and Urban System in India*
11. Rob Krueger, David Gibbs, *Sustainable Development*, Guilford Press, 2007.
12. Andrews Blowers, *Planning for a Sustainable Environment,* Guilford Press.
13. Agarwala S. C., *Architecture and Town Planning*, Dhanpat Rai Publications, New Delhi.
14. Chen, K., *Energy Management in Illuminating Systems*, CRC Press, Boca Raton, Florida. 1999.
15. Allard, F., *Natural Ventilation in Buildings: A Design Handbook*, James & James, London. 1998.
16. Ghosh S., *Solar Architecture and Planning*, Centre for Built Environment, Calcutta.
17. Frey, H. W., *Designing the City: Towards A More Sustainable Form*, E & FN Spon, London, 1999.
18. Roelofs, J., Greening Cities: Building Just and Sustainable Communities, Bootstrap Press, New York.
19. Bose B. C., *Integrated Approach to Sustainable Development*, Rajat Publications, Delhi.
20. Laurie Baker, *Chamoli Earthquake Hand book*, Costford.
21. Fuller Moore, *Environmental control systems Heating, Cooling, Lighting*, McGraw Hill, New York.
22. Langston C. A., G. K. C. Ding, *Sustainable Practices in Built Environment*, Butterworth Heinemann.
23. Trivedi R. N., *Environmental Sciences*, Anmol Publications, New Delhi.
24. Wright R. T. and B. J. Nebel, *Environmental Sciences-Towards Sustainable Future*, Prentice Hall of India, New Delhi.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course outcome:

After successful completion of the course, the students will:

- *be able to identify creative principles and styles of architecture.*
- *possess a basic knowledge in urban development and planning*
- *be able to comprehend architecture and urban development from sustainability perspective.*

13.804 CONSTRUCTION MANAGEMENT (C)

Teaching Scheme: 3(L) - 0(T) - 0(P) **Credits**: 3

Course Objectives:

- *To make a student aware of the evolution of management thought.*
- *To follow the life cycle of a civil engineering project, from its conception to completion.*
- *To make a student aware of the state-of-the-art computer tools in management.*
- *To give an overview of construction economics, which will help a student to assess the financial feasibility of projects and aid in decision making.*
- *To make a student aware of the governmental system of project execution, starting from floating a tender to contract conditions.*
- *To provide a deeper understanding of scheduling techniques.*

Module – I

Management – definition – Evolution of management thought - Scientific management – pioneers in scientific management - principles of management advocated by Taylor and Fayol - relevance in the construction industry - Construction management – need - objectives – functions - construction team – resources in construction industry – managerial functions.

Module – II

Construction project management – types of construction projects - different phases in the life cycle of a construction project. Construction economics - time value of money - techno-economic feasibility study - cost benefit analysis - rate of return analysis. Computer capabilities in management.

Module – III

Bidding – tenders - types of tenders - tendering procedure – award of tenders – qualification of contractors – contracts – contract documents – important clauses in construction contracts - types of contracts – execution of works.

Module – IV

Introduction to Construction Scheduling techniques – Work break down structure - Types of Schedules – Material schedule – labour schedule – equipment schedule – financial schedule –Scheduling using Bar chart - Mile Stone Charts - Network representation – Activity on Node Diagram - Network analysis – Critical Path Method - Programme Evaluation and Review Technique – Time-cost trade-off – Basic concept of resource planning (problems not needed).

References

1. Chitkara K. K., *Construction Project Management: Planning, Scheduling and Controlling*, 3/e, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Sengupta B. and H. Guha, *Construction Management and Planning*, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi.
3. Punmia B. C. and K. K. Khandelwal, *Project Planning and Control with PERT and CPM*, Laxmi Publications (P) Ltd.
4. Srinath L. S., *PERT and CPM- Principles and Applications*, 3/e, Affiliated East-West Press Pvt. Ltd., New Delhi.
5. Wiest J. D. and F. K. Levy, *A Management Guide to PERT / CPM with GERT/ PDM/ DCPM and Other Networks*, 2/e, Prentice Hall of India Pvt. Ltd., New Delhi.
6. Weber S. C., *Scheduling Construction Projects: Principles and Practices*, Pearson.
7. Jha K. N., *Construction Project Management: Theory and Practice*, Pearson.
8. Koontz H. and H. Weihrich, *Essentials of Management*, Tata McGraw Hill.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *No charts, tables, codes are permitted in the Examination hall. If necessary, relevant data shall be given along with the question paper by the question paper setter.*

Course outcome:

After successful completion of the course, the students will be able to:

- *Describe construction management concepts in the backdrop of construction industry.*
- *Explain the life cycle of a construction project.*

- *Relate to the popular computer tools used in project management.*
- *Prepare tender and contract documents of civil engineering works based on prevailing rules and regulations.*
- *Formulate construction schedules.*
- *Apply efficient strategies for resource management.*

13.805.1 EARTHQUAKE RESISTANT DESIGN OF STRUCTURES (C) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To learn the basics of analysis of structures subjected to earth quake load*
- *To provide an understanding of fundamental knowledge of earth quake resistant design of structures.*

Module – I

Review of basic structural dynamics– SDOF systems subjected to harmonic loads – Base motion – Vibration isolation. MDOF systems- Lumped mass systems- Determination of natural frequencies and mode shapes- Mode superposition method. Earthquakes – Causes of Earthquakes –Plate tectonics - Elastic rebound theory- Seismic waves – Measurement of earthquakes – Intensity and magnitude- Measures of magnitude- Seismic zoning.

Module – II

Response Spectrum – Characteristics- Elastic Design Spectrum – Seismic demand diagrams, Earthquake effects on buildings – Effect of architectural features and structural irregularities – Vertical irregularities - Torsion irregularity.

Module – III

Seismic design philosophy – Determination of design lateral forces – Equivalent lateral force method - Dynamic analysis by response spectrum method. Ductility - Measures of Ductility – Factors affecting ductility.

Module – IV

RC structures - Effect of confinement of concrete Ductility considerations in earthquake resistant design of RC buildings – Discussion of relevant clauses in IS 13920 for earthquake resistant design of RC beams, columns and shear walls. Basics of capacity based design Masonry buildings - Earthquake resistant construction practices.

References:

1. IS 1893 (Part I) : 2002 Criteria for Earthquake Resistant Design of Structures- Part I General Provisions and buildings.
2. IS 4326 : 1993, Earthquake Resistant Design and Construction of Buildings - Code of Practice, Bureau of Indian Standards, New Delhi.
3. IS 13920 : 1993, Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces - Code of Practice.

4. Chopra A. K., Dynamics of Structures, Prentice-Hall, India.
5. Agrawal P. and M. Shrinkande, Earthquake Resistant Design of Structures, PHI.
6. Duggal S. K., Earthquake Resistant Design of Structures, Oxford University Press, India.
7. Park R. and T. Paulay, Reinforced Concrete Structures, John Wiley & Sons.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Use of IS 1893 (Part I) : 2002 and IS 13920 : 1993* are *allowed in the examination.*

Course Outcome:

After successful completion of the course, the students will have the capability to design earth quake resistant structures and gained knowledge about seismic resistant construction practices.

13.805.2 WIND LOADING ON STRUCTURES (C) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To introduce in detail about the wind load computations on structures as per the Indian Standards*
- *To introduce the dynamic behavior of wind on structures*
- *To learn the wind load computations on structures of typical shape and special applications.*

Module – I

Wind and its characteristics-nature of winds-types of winds-Extreme wind conditions-aerodynamics of civil Engineering structures. Characteristics of wind-gradient wind speed-maximum Wind speed, mean wind speed, wind as a random process. Computation of wind speed.

Module – II

Wind pressure and static wind forces on buildings – pressure coefficients, internal and external pressure coefficients, local effects/coefficients. Force coefficients – buildings and individual members. Computation of static wind force on building envelops and other structures exposed to wind.

Module – III

Gust effectiveness factor method in wind load calculation, along wind loads, across wind loads, wind tunnel model studies. Application of gust effectiveness factor in the calculation of wind load on buildings and structures.

Module – IV

Dynamic effect of wind on structures, galloping, fluttering and ovalling. Vortex shedding.

Calculation of wind load on special structures such as rail/road bridges, RCC/steel chimneys, overhead transmission line towers, natural draught cooling towers.

References:

1. Holmes J. D., *Wind Loading of Structures*, Spon Press, London , 2001
2. IS 875 (Part 3)- 1987, IS 4998, IS 6533- 1989, IS 5613- 1985, IS 802 -1995, IS 11504-1985.
3. Dyrbye and Hansen, *Wind Load on Structures*, John Wiley and Sons, 1997.
4. Taranath, *Wind and Earthquake Resistant Buildings – Structural Analysis and Design*, Marcel Dekker, 2005.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** Use of IS 875 (part 3) is permitted in examination hall.*

Course Outcome:

After successful completion of this course, the students will be able to

- *Calculate the wind induced force on various structures*
- *Compute and compare the wind loads on different structures using different approaches outlined in IS code*
- *Compute wind load on special structures as per the relevant IS codes.*

13.805.3 DEEP FOUNDATIONS (C) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To expose the students to the design of piles, pile groups and caissons with respect to vertical loads*
- *To enable the students to acquire proper knowledge about different types of deep foundations and its selection based on practical situations.*

Module – I

Necessity of pile foundation – classification of piles – Factors governing choice of type of pile – Load transfer mechanism –effect of pile installation on soil condition – criteria for pile socketing- Ultimate skin friction and end bearing capacity of single pile installed in granular soils based on SPT and CPT values- Basis of dynamic formulae- General comments on the reliability of dynamic formulae - The rational pile formula- Pile driving stresses- Conventional and cyclic pile load tests – Interpretation of field test and pile load test results.

Module – II

Piles for resisting uplift - Tension piles of uniform diameter in clays and sands - Tension piles with enlarged base in clays-under reamed piles-capacity and installation as per IS

Pile groups – Pile group configurations - Group action – Efficiency of pile groups - Group capacity – Minimum spacing of piles in a group – Negative skin friction of pile groups – Settlement of pile groups in clays – Equivalent raft approach - Settlement of pile groups in sands - Skempton's and Meyerhof's methods.

Module – III

Drilled piers- Types -construction Procedures-load transfer mechanism- estimation of load-bearing capacity in sand and clay-load carrying capacity based on settlement- uplift capacity of drilled piers.

Module – IV

Well Foundations –Types- components- Problems encountered in well sinking – Tilts and Shifts – Causes – Permissible tilts and shifts - Methods to rectify tilts and shifts – Forces acting on a well foundation- Procedure for construction and sinking of wells – Thickness of well steining for sinking under self weight - Grip length - design methods (Terzaghi, IS approaches), check for stability, base pressure.

References:

1. Gopal Ranjan and A. S. R Rao, *Basic and Applied Soil Mechanics*, New Age International, New Delhi, 2002.
2. Arora K. R., *Geotechnical Engineering*, Standard Publishers Distributors, New Delhi, 2006.
3. Venkatramaiah, *Geotechnical Engineering*, Universities Press, 2000.
4. Poulos, H.G.and E. H. Davis, *Pile Foundation Analysis and Design*, John Wiley and Sons, New York, 1980.
5. Das B. M., *Principles of Foundation Engineering, Design and Construction*, 4/e, PWS Publishing, 1999.
6. Varghese P. C., *Foundation Engineering*, PHI Learning Private Limited, New Delhi, 2005.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of the course, the students will be able to:

- *Design deep foundations according to site requirement.*
- *Determine the load carrying capacity of different types of deep foundations.*

13.805.4 EARTHQUAKE GEOTECHNICAL ENGINEERING (C) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

Understanding the basic seismology concepts ; Estimation of liquefaction potential; Measurement of dynamic soil properties; Estimation of Bearing Capacity under seismic loading; Seismic design of retaining walls.

Module – I

Seismology and earthquakes (basic concepts only)- Earthquake hazards related to Geotechnical engineering- Wave propagation-Soil liquefaction-Suceptability,initiation and effects of soil liquefaction-Laboratory and field methods for estimation of liquefaction potential-CSR and CRR.

Module – II

Measurement of dynamic soil properties-Seismic reflection and seismic refraction tests-Seismic cross hole, down hole/uphold tests-SPT-High strain element tests-Cyclic tri-axial test-Shake table and centrifuge tests.

Module – III

Introduction to bearing capacity and settlement analysis under earthquake loading-Bearing capacity analysis for liquefied soil, Bearing capacity for granular soil with earthquake induced pore pressure, Bearing capacity analysis for cohesive soil weakened by earthquake, Seismic design consideration- Earthquake Provisions in building codes.

Module – IV

Site improvement methods for mitigation for earthquake hazards: stone columns, dynamic compaction, vibroflotation. Dynamic response of retaining walls- pseudo static Method for stability analysis, Numerical example for Seismic designs of retaining walls.

References:

1. Robert W. Day, *Geotechnical Earthquake Engineering Handbook*, McGraw Hill, New York, 2007.
2. Kramer S., *Geotechnical Earthquake Engineering*, Pearson, New Delhi, 1995.
3. Ishihara K., *Soil Behaviour in Earthquake Geotechnics*, Oxford Science, New York, 1996.
4. Lkuo Towhata, *Geotechnical Earthquake Engineering*, Springer, New York, 1995.
5. Kamalesh Kumar, *Basic Geotechnical Earthquake Engineering*, New Age International Publishers, New Delhi, 2009.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of the course, the student will get an overall view of the nature of seismic hazards, the methods used to assess their impacts and the techniques available to mitigate their damaging effects.

13.805.5 URBAN WATER MANAGEMENT AND ENVIRONMENTAL HYDRAULICS (C) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To communicate the basic knowledge on urban flooding and its control measures*
- *To equip the students to perform the design of urban storm water drains*
- *To train the students to estimate the design flood and perform flood routing in channels*
- *To impart knowledge on pollutant transport through open channels and its modeling*
- *To impart knowledge on pollutant transport through soils*
- *To convey the basic knowledge on groundwater pollution.*

Module – I

Urban hydrology –urban flooding-causes of flooding-Methods of flood warning, prevention and control-flood defense systems.
Intensity-duration – frequency relationships-Design storm and Probable Maximum Precipitation Design of urban storm water collection system-Gutters, inlets and sewers-rational formula-limitations-Storm water pollution and control (basic concepts)-Best management practices for urban drainage-constructed treatment wetlands (No design).

Module – II

Hydrologic extremes –floods and droughts. Standard project flood and probable maximum flood Design floods and its estimation by different methods, flood frequency analysis-Gumbel's method.
Flood routing – hydrologic routing and hydraulic routing. Channel routing and reservoir routing (conceptual ideas). Muskingum method of channel routing-fixing of parameters. Estimation of drought-different drought indices (basic ideas only).

Module – III

Role of fluid mechanics in environmental planning-turbulent flow-momentum equations - dispersion-diffusion – advection - Fick's law - Classical solutions of pollutant transport - determination of downstream concentration - estimation of width of plume and length required for complete mixing-simple problems - Theory of jets and plumes - Richardson number - Types of jets-density stratification in lakes and reservoirs - Densimetric Froude number.

Module – IV

Contaminant propagation through soil-different mechanisms-hydraulic aspects of pollutant transport (basic ideas only)-Quality of groundwater- pollution of ground water-sources, distribution and evaluation of ground water pollution, cleaning of aquifers (Brief description only). Sea water intrusion-Ghyben-Herzberg equation-seawater freshwater interface-upconing preventive measures. Environmental impacts of different types of water resources projects-brief description only.

References:

1. Akan A. O., *Urban Storm Water Hydrology: A Guide to Engineering Calculations*, Lancaster Technomic, 1993.
2. Canter L. W., *Environmental Impact assessment*, McGraw Hill, New York, 1977.
3. Sharma H. D. and K. R. Reddy, *Geo Environmental Engineering*, John Wiley and Sons, 2004.
4. Hitel Rubin and Joseph Atkinson, *Environmental Fluid Mechanics*, CRC Press, London.
5. Johnathan Parkinson and Mark Ole, *Urban Storm Water Management in Developing Countries*, IWA, London, 2005.
6. Larry Mays, *Storm Water Collection Systems Design Handbook*, McGraw Hill, New York.
7. Streeter V. L., E. B. Wylie and K. W. Bedford, *Fluid Mechanics*, WCB/McGraw Hill, 1998.
8. Liggett J. A., *Fluid Mechanics*, McGraw Hill international, Singapore, 1994.
9. Subramanya K., *Engineering Hydrology*, TMH Publishers
10. Ven Te Chow, *Hand book of Applied Hydrology*, Tata McGraw Hill.
11. Jayarami Reddy P. A., *Text Book of Hydrology*, Laxmi Publications (P) Ltd.
12. Todd D. K., *Ground Water Hydrology*, Wiley International Ed; Toppan & Company Ltd, Tokyo, 1995.
13. Raghunath H. M., *Ground Water Hydrology*, Wiley Eastern Limited.
14. Rastogi A. K., *Numerical Groundwater Hydrology*, Penram Intl. Publishers, Mumbai.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of the course, the students will be able to:

- *describe the causes of urban flooding and its control measures*
- *perform the design of urban storm water drains*
- *estimate design flood and perform flood routing in channels*
- *model the pollutant transport through open channels*
- *describe the mechanism of pollutant transport through soil*
- *describe the causes and remedies of groundwater pollution.*

13.805.6 ENVIRONMENTAL IMPACT ASSESSMENT (C) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

To give an in-depth idea regarding the EIA methodology giving importance to environmental impact assessment techniques which are not covered in other environmental related subjects.

Module – I

Introduction- Components of Environment- Man and Environment – Health and Environment – Environmental Ethics – Interdisciplinary nature of Environment -Sustainable development – Social, economical and environmental dimensions–Definition of EIA - Evolution of EIA (Global and Indian Scenario) - Key Features of US National Environmental Policy Act (1969).

Module – II

Elements of EIA – Purpose – Screening – Scoping - Terms of Reference - Public Consultation - Environmental Clearance process followed in India - Key Elements in 1994 & 2006 EIA (Govt. of India) Notification.

Module – III

Socio-economic impacts - Impact types- Identification- Impact assessment Methodologies- Overlays, Checklist, Matrices, Fault Tree Analysis, Event Tree Analysis- Role of an Environmental Engineer- Public Participation- Introduction to latest softwares in water and air quality Modeling.

Module – IV

Water Quality Analysis- Standards for Water, Air and Noise Quality - Impact of development on vegetation and wild life-Environmental Management Plan- EIA- Case study related to Hydro electric Project.

References:

1. Larry W Canter, *Environmental Impact Assessment*, McGraw Hill Inc., New York.
2. *EIA Notification*, Ministry of Environment & Forests, Govt. of India, 2006.
3. .Rau G J and Wooten C.D, *EIA Analysis Hand Book*, McGraw Hill.
4. Robert A Corbett, *Standard Handbook of Environmental Engineering*, McGraw Hill.
5. John Glasson, Riki Therivel and S. Andrew Chadwick, *Introduction to EIA*, University College London Press Limited.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of the course, the students will be able to prepare an Environmental Impact Assessment report for a given developmental project.

13.805.7 DESIGN AND CONSTRUCTION OF PAVEMENTS (C) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

To understand the basic principles of pavement design and applications of these principles in solving problems under varying circumstances in pavement design.

Module – I

Stresses in Flexible pavements-Elastic Layered systems- Boussinesq and Burmisters theory, Two layer and three layer systems, Fundamental design concept; Vehicle and Traffic consideration in design-Fixed traffic and fixed vehicle, equivalent single wheel loads, equivalent axle load factors, Traffic wander, estimation of design traffic volume; Material input in pavement design- Resilient (Elastic) modulus of pavement materials; Flexible pavement design by IRC 37-2012.

Module – II

Rigid Pavements-Westergaard's approach-Bradbury's stress coefficients-IRC method of design. Temperature Stresses in Concrete pavements-Warping stress-Frictional Stress-Combination of stresses. Joints in Concrete pavements-Necessity-requirements-Types-Expansion joints-Contraction Joints-Construction joints. Design of joints-dowel bars and tie bars.

Module – III

Road Construction- Wet mix macadam, bituminous macadam, premix carpet, bituminous concrete. Highway drainage-principles of surface drainage-Design of cross section of drainage channel-sub surface drainage, base drainage, sub grade drainage.

Module – IV

Pavement Evaluation and Rehabilitation - Concepts of Present serviceability index, Functional evaluation of Roads - MERLIN and Bump integrator, Flexible and Rigid Pavement distresses. Structural evaluation of pavements- Benkleman beam and Falling weight deflectometer. Design of flexible pavement overlay by IRC 81 and 115.

References:

1. Khanna S. K. and C. E. G. Justo, *Highway Engineering*, Nem Chand & Bros, Roorkee.
2. Yang H. Huang, *Pavement Analysis and Design*, Prentice Hall
3. Partha Chakraborthy and Animesh Das, *Principles of Transportation Engineering*, Prentice Hall India.
4. Yoder E. J. and M. W. Witczak, *Principle of Pavement Design,* John Wiley, 1975.

5. Huang Y. H., *Pavement Analysis and Design*, Pearson, 2008.
6. IRC Codes for Flexible Pavements; IRC: 37-2012, IRC: 109-1997, IRC: 27-1967, IRC:29-1988, IRC:94-1986, IRC: 19-1997, IRC:81-1997, IRC:115-2014.
7. IRC Codes for Rigid Pavements: IRC 58-2002, IRC 57-1974.
8. Srinivasa Kumar R., *Highway Engineering*, Universities Press (India), 2011.
9. Nicholas J. Garber and Lester A. Hoel, *Principles of Traffic and Highway Engineering*, CENGAGE Learning, New Delhi, 2012.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Use of IRC Codes given in References 4 and 5 are permitted in examination hall.*

Course Outcome:

After successful completion of the course, the students will be able to propose quality pavement design to cater to the demand of the society.

13.805.8 REPAIR AND REHABILITATION OF STRUCTURES (C) (Elective III)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To introduce the causes of deterioration in structures and the need for maintenance*
- *To expose the students to diagnosis and assessment of deterioration using NDT*
- *To impart the methods of repair and rehabilitation of distressed structures.*

Module – I

Causes of deterioration in concrete structures – errors in design, construction operations, earthquakes, erosion, chemical reaction, corrosion and durability.
Causes of deterioration in steel structures – corrosion, abrasion, loosening of connections, fatigue, impact, earthquakes and environmental problems.
Preventive measures, maintenance and inspection.

Module – II

Diagnosis and assessment of deterioration, visual inspection, non destructive tests, Ultrasonic pulse velocity method, Rebound hammer method, Pull out tests, Windsor probe test and crack detection techniques.

Module – III

Methods of repair of cracks, repairing spalling and disintegration, repairing concrete floors and pavements, repairing of corrosion damage of reinforced concrete, repair of steel structures.

Module – IV

Strengthening of existing structures, guniting, jacketing, use of chemicals, application of polymers, ferrocement and fibre concretes, pre-stressing, surface coatings, painting, water proofing, grouting, special repairs.

References:

1. Sidney M. Johnson, *Deterioration, Maintenance and Repairs of Structures*, McGraw Hill Book Company, New York, 1965.
2. Kaminetzky D., *Design and Construction Failures- Lessons from Forensic Investigations*, Galgotia Publication, New Delhi, 2008.
3. Jacob Feld and Kenneth L. Carper, *Construction Failures*, Wiley Interscience,1996.
4. Vidiveli B., *Rehabilitation of Concrete Structures*, Standard Publishers, 2009.
5. Modi P. I. and C. N. Patel, *Repair and Rehabilitation of Concrete Structures*, PHI, 2016.

6. Varghese P. C. and C. N. Patel, *Maintenance, Repair &Rehabilitation & Minor Works of Buildings*, PHI, 2014.
7. Guha P.K., *Maintenance and Repairs of Buildings*, New Central Book Agency, 2011.
8. Richardson Barry, *Defects and Deterioration in Buildings: A Practical Guide to the Science and Technology of Material Failure,* Taylor& Francis, 2002.
9. Stephen E. Petty, *Forensic Engineering: Damage Assessments for Residential and Commercial Structures*, CRC Press, 2013.
10. Delatte N. J., *Beyond Failure: Forensic Case Studies for Civil Engineers*, ASCE, 2008.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of the course, the students will be able to

- *Describe the various causes of deterioration of structures*
- *Diagnose, analyse and assess the deterioration of structures using NDT*
- *Decide the type of repair and the method of rehabilitation, most suited and economical for a distressed structure considering safety aspects.*
- *Compose the maintenance procedure to increase the durability of the structure*

13.806.1 FINITE ELEMENT METHOD (C) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To provide an understanding of fundamental knowledge and technique of Finite Element Method.*
- *To develop tools to analyse engineering problems using FEM and typical commercial FEA package.*

Module – I

Basics of 2D elasticity- Equations of equilibrium- Strain-displacement relation- Stress-strain (constitutive) relation- Energy principles- Principle of virtual work- Principle of stationary potential energy- Variational formulation- Rayleigh-Ritz method- Introduction to Weighted residual methods- Evolution of FEM- Outline of the FE procedure. Review of Matrix Structural Analysis (Direct Stiffness Method).

Module – II

Element properties- Displacement functions- Convergence requirements- Equilibrium and compatibility in the solution- Development of equilibrium equation- Types of finite elements- Development of shape functions for truss, beam and frame elements- CST, LST- Bilinear plane rectangular elements. Shape functions for C0 and C1 elements. Lagrangian and Hermitian Interpolation functions for one and two dimensional elements. Lagrange and Serendipity elements.

Module – III

Element stiffness Matrix – Assembly of elements – Static condensation - Node numbering to exploit matrix sparsity – Storage techniques of stiffness matrix. Displacement boundary conditions. Gauss quadrature technique- Development of consistent nodal load vector. Development of stiffness matrix for truss and beam elements. Solution techniques for Linear Algebraic equations.

Module – IV

Concept of Isoparametric formulation- Line element- Plane bilinear element- Subparametric and superparametric elements- Plane stress and plane strain problems- Patch test. Introduction to plate and shell elements- Types of 3D elements- Discussion of finite element packages.

References:

1. Cook R. D., D. S. Malkus and M. E. Plesha, *Concepts and Applications of Finite Element Analysis*, John Wiley & Sons, Singapore, 1981.

2. Krishnamoorthy C. S., *Finite Element Analysis- Theory and Programming*, Tata McGraw Hill, New Delhi, 1994.
3. Bathe K J, *Finite Element Procedures in Engineering Analysis*, Prentice Hall, New Delhi, 1982.
4. Zienkiewicz O C and Taylor R W., Finite Element Method, Elsevier Butterworth Heinemann, UK, 2005.
5. Rajasekharan S, *Finite Element Analysis in Engineering Design*, Wheeler, New Delhi, 1993.
6. Chandrupatla T. R. and A. D. Belegundu, *Introduction to Finite Elements in Engineering*, Pearson Education, New Delhi, 1997.
7. Hutton D. V., *Fundamentals of Finite Element Analysis*, Tata McGraw Hill Education Private Ltd., New Delhi, 2005.
8. Mukhopadhyay M. and Abdul Hamid Sheikh, *Matrix and Finite Element Analyses of Structures*, Ane Books Pvt. Ltd., New Delhi, 2009.
9. Reddy J. N., *An Introduction to FEM*, McGraw Hill Book Co. New York, 1984.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of the course, the students will be able to:

- *Analyse and build FEA model for various engineering problems.*
- *Gain confidence in learning and using new finite element packages.*

13.806.2 DESIGN OF BRIDGES (C) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

To give a clear idea regarding the theory and design methods of various forms of bridges.

Module – I

Classification and components of bridges - Selection of bridge types.-Review of road, railway bridge specifications and IRC provisions. R.C.Bridges - Grid analysis, Introduction to Courbon's method, Hendry- Jaegar method, Guyon Massonet method, Orthotropic plate theory. Design of R.C. Slab bridge decks- T-beam and slab bridges.

Module – II

Pre stressed concrete bridges- Advantages-Introduction to various forms, Design of single span slab bridges- Design of end block.

Module – III

Steel bridges- Types of floor systems- Design of plate girder bridges- Design principles of horizontal truss bracings- end cross frames. Truss girder bridges-Types. Design principles of through type truss girder bridges for broad gauge railway.

Module – IV

Foundations and Sub structures-Types of foundations - Discussion of open well, pile foundations. Pneumatic caisson (Theory only). Piers, abutments, bed block-Forces on piers and abutments, Design adequacy of piers and abutments. Bearings -Types-Design of concrete steel bearings, Design of elastomeric pad bearings.

References:

1. Johnson Victor D., *Essentials of Bridge Engineering*, Oxford& IBH Publishers.
2. Jagadeesh T. R. and M. A. Jayaraman, *Design of Bridge Structures*, Prentice Hall.
3. Krishnaraju N., *Design of Bridges*, Oxford& IBH Publishers.
4. Krishnaraju N., *Pre stressed Concrete Bridges,* CBS Publishers.
5. RamChandra, *Design of Steel Structures Vol. II*, Standard Book House, New Delhi.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks. Design problems should be specific and the students should be able to answer within the stipulated time.

***Note:** Use of IRC 5-1998, IRC 6-2000, IRC 21-2000, IRC 18-1985, IRC 24-2000, IRC 27-2009, IRC 83-1987, IS 456-2000, IS 800-2007are permitted in the examination hall.*

Course Outcome:

After successful completion of the course, the students will be able to select a particular form of bridge to suit the requirements and analyse, design the same.

13.806.3 REINFORCED EARTH (C) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

Detailed understanding of the history and mechanism of reinforced soil; Knowledge of the various types of geosynthetics, their functions and applications; detailed knowledge about the design of few reinforced soil structures.

Module – I

Introduction-history-ancient and modern structures-application areas. Functions of geosynthetics. Reinforcement action-Equivalent Confining Stress concept, Pseudo Cohesion Concept, Concept of Expanding soil mass. Advantages and disadvantages of reinforced soil-simple problems. Component materials and their properties-fill, various types of reinforcements with advantages, disadvantages, facing- Factors affecting the performance and behaviour of reinforced soil.

Module – II

Design and analysis of reinforced soil retaining walls-General aspects-External stability of vertically faced reinforced soil retaining wall. Internal stability- Tie back wedge analysis and coherent gravity analysis or reinforced soil retaining walls with metallic strip and continuous geosynthetic reinforcements. Assumptions and problems.

Module – III

Construction methods of reinforced retaining walls- Concertina Method- Telescopic method- Sliding method. Segmental facings. Bearing capacity improvement using soil reinforcement- Binquet and Lee's analysis- Simple problems in bearing capacity of reinforced soil foundation.

Module – IV

Concept of Geocells, encased stone columns, prefabricated vertical drains, geocomposites, soil nailing, geotubes, geobags (only basic concepts). Natural geotextiles using coir and jute with relative advantages and disadvantages, application areas.

References:

1. Jhones C. J. F. P., *Earth Reinforcement and Soil Structures*, Butterworth, London, 1985.
2. Sivakumar Babu G.L., *An Introduction to Soil Reinforcement and Geosynthetics*, 2007.
3. Koerner R. M., *Designing with Geosynthetics*, 4/e, Prentice Hall, New Jersey, 1999.
4. Rao G. V., *Geosynthetics-An Introduction*, Sail Master Geoenvironmental Services Pvt. Ltd, Hyderabad, 2007.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: No charts, tables, codes are permitted in the Examination hall. If necessary relevant data shall be given along with the question paper by the question paper setter.

Course Outcome:

Ability to adopt reinforced soil technique against conventional techniques; Ability to select suitable reinforcement material and type to suit the functional requirements; Carry out analysis and design of reinforced soil structures.

13.806.4 ADVANCED FOUNDATION ENGINEERING (C) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

The student will be able to

- *Design shallow foundations for eccentric loading using Meyerhoff's method*
- *Evaluate the earth pressure behind retaining walls by graphical methods*
- *Evaluate the lateral load capacity of vertical piles by Brom's approach*
- *Design cantilever and anchored sheet pile walls.*

Module – I

Meyerhof's method for estimation of bearing capacity of isolated footings (no derivation required) – Effect of water table and inclination of loading on bearing capacity- Footings subjected to moments – eccentric loading – Solution using the two approaches proposed by Meyerhof.

Module – II

Graphical methods for lateral earth pressure on retaining walls -Active earth pressure (cohesion less backfill only) by Rebhann's method & Culmann's method– Advantages –– Earth pressure on retaining walls with earthquake forces -layered backfills Extension of Coulomb's theory (no derivation required)– locating safe distance of line load by Culmann's method-Design of gravity retaining walls.

Module – III

Sheet pile walls – Types and uses and construction –Deflection diagram of cantilever sheet pile wall in sand- Analysis of cantilever sheet pile wall in granular and clayey soils-anchored bulkheads-fixed earth and free earth support method of analysis in cohesion less soil only.

Module – IV

Laterally loaded piles –fixed head and free headed piles- Ultimate lateral resistance and deflection of vertical piles in sand and clay by Brom's approach – Methods to improve lateral stability of piles.

References:

1. Gopal Ranjan and A. S. R. Rao, *Basic and Applied Soil Mechanics*, New Age International (P) Limited, New Delhi, 2002.
2. Arora K.R., *Geotechnical Engineering*, Standard Publishers Distributors, New Delhi, 2006.
3. Venkatramaiah, *Geotechnical Engineering*, Universities Press (India) Limited, Hyderabad, 2000
4. Poulos H. G., Davis E. H., *Pile Foundation Analysis and Design*, John Wiley and Sons, New York, 1980.

5. Das B. M., *Principles of Foundation Engineering, Design and Construction*, Fourth Edition, PWS Publishing, 1999.
6. Varghese P. C., *Foundation Engineering*, PHI Learning Private Limited, New Delhi, 2005.
7. Joseph E. Bowles, *Foundation Analysis and Design*, McGraw Hill Inc., New York, 1988.
8. Nayak N. V., *Foundation Design Manual*, Dhanpat Rai & Sons, 1996.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

***Note:** Use of Meyerhof's and Brom's charts are permitted in the examination. Assume any other suitable data if necessary..*

Course Outcome:

After successful completion of the course, the students will be able to:

- Design shallow foundations for eccentric loading using Meyerhoff's method
- *Evaluate the earth pressure behind retaining walls by graphical methods*
- *Design cantilever and anchored sheet pile walls*
- *Evaluate the lateral load capacity of vertical piles by Brom's approach*

13.806.5 IRRIGATION AND DRAINAGE ENGINEERING (C) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

To understand the concept of irrigation water scheduling, distribution and system performance.

Module – I

Soil Plant Water relationships-soil physical properties influencing irrigation-kinds of soil water-movement of water into soils-infiltration and measurement-soil moisture retention and movement-soil moistur**e** tension-total soil water potential-soil moisture characteristics-soil moisture constants-measurement of soil moisture-tensiometer, neutron moisture probe (only concepts). Plant water relationships- Crop response to water-moisture stress and plant response-drought tolerance–root characteristics and moisture use-evaporation, transpiration and consumptive use-measurement of evapotranspiration-Estimating evapotranspiration from evaporation and climatological data-methods (Blaney criddle, Thornthwaite, Penman and Christiansen only)-Crop co-efficient and evapotranspiration of a crop.

Module – II

Surface Irrigation methods- classification – border irrigation –design parameters- furrow irrigation- design parameters type of furrows- Basin irrigation- type of basins- efficiency of surface irrigation methods. Irrigation requirement- soil water balance-yield response to water-Production functions- Scheduling of irrigation- criteria of scheduling constraints – frequency and interval of irrigation- irrigation system performance indicators- Irrigation water distribution- Canal network and canal regulation- methods of distribution- supply based and demand based- Measurement of irrigation water-methods-velocity area method-measuring structures like weirs, Parshall flumes, orifices, and meter gates-tracer methods.

Module – III

Land Drainage Systems: necessity –types – surfaces and subsurface drainage –design considerations. Soil Water Zone : Description, Flow through soil water zone – physical properties of soil –hydraulic conductivity – saturated thickness-drainable pore space – storativity, hydraulic resistance, leakage factor – Ground water data-concepts of Ground water hydrograph, ground water maps, Isobath map and water table fluctuation maps. Drainage studies-continuity equation, Laplace equation , relaxation method of solution-Typical boundary conditions like impervious layer, plane of symmetry, free water surface, water at rest or slowly moving water, seepage surface- Dupit Forchheimer Theory- steady flow above an impervious horizontal boundary Dupits equation- water table subject to recharge. Flow into open drains- steady state equation- Hooghoudt equation, Principles,

applications for design use of nomographs for homogeneous and layered soils – Earnst equation, concept of horizontal vertical and radial flow, application to layered soils.

Module – IV

Layout of open drainage systems, types- Field drains- design considerations of ditch drains- mole drains, design considerations, suitability- sub-surface drainage systems-pipe drainage systems- design for uniform and non- uniform flow conditions. Salinity and drainage-cause of salinity, salt balance equation, leaching efficiency, salt equilibrium equation and leaching requirement—salt storage equation –expressing equations in electrical conductivity terms. – Design of a drainage system for an irrigated area based on crop water requirement and leaching requirement.

References:

1. Michel A. M., *Irrigation Theory and Practice*, Vikas Publishing House, New Delhi.
2. Bhattacharaya A. K. and A. M. Michel*, Land Drainage Principles: Methods and Applications,* Konark Publishers, New Delhi.
3. *Irrigation and Drainage Paper No. 24*, Crop Water Requirements FAO, Rome, 1977.
4. Kessler J., *Drainage Principles and Applications*, Vol I to IV, ILRI, Netherlands.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of the course, the students will be able to understand the concepts of irrigation practices and scheduling.

13.806.6 INDUSTRIAL WASTEWATER MANAGEMENT (C) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

To impart knowledge on sources and characteristics of various industrial wastes and strategies for its treatment.

Module – I

Introduction-Effects of industrial wastewater on streams- effects of industrial wastewater in sewage treatment plant, Joint treatment of raw industrial waste and partially treated industrial waste with domestic sewage, Waste minimization techniques - Volume and Strength reduction - reuse, recycle, recovery, source reduction, raw material substitution, process modification.

Module – II

Stream quality criteria for water supply and aquatic life, Stream sanitation- deoxygenation and self purification of streams, re aeration constants, oxygen sag curve, Stream sampling, computation of waste loads on streams, Stream protection measures-stream standards and effluent standards.

Module – III

Theories of treatment - Neutralisation, acidification, causticisation and bascity factor, equalisation, proportioning -Removal of suspended solids and colloids, Removal of organic and inorganic dissolved solids, Separation of emulsions -emulsion breeding techniques-oil separation.

Module – IV

Industrial manufacturing process - Sources and characteristics of wastes and waste treatment methodologies for specific industries eg: Tannery waste, pulp and paper industry, textile industry, food processing industry, energy industry, iron and steel industry, toxic wastes.

References:

1. Nemerow N. L., *Liquid Waste of Industry- Theory, Practice and Treatment*, Addison Wesley, 1972.
2. Ronald. Decoste, *Theory and Practices of Water and Wastewater Treatment*, John Wiley and Sons, 1996.
3. Southgate B. A., *Treatment and Disposal of Industrial Waste Waters,* H. M. Stationery Office, London, 1948.
4. Shell N. J., *Industrial Pollution Control,* Academic Press, 1981.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of the course, the students will be able to

- *Identify the source of wastewater and categorize their characteristics*
- *Plan for minimizing the production of industrial waste*
- *Recommend the various methods for the treatment of industrial waste.*

13.806.7 TRAFFIC ENGINEERING (C) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

The overall aim of the course is to provide fundamental knowledge of various surveys required in traffic engineering, traffic flow theory and its application, methods for capacity analysis, design, management, operation and safety.

Module – I

Traffic Engineering: Definition, Functions. Road User, Vehicle and The Road: Human factors governing road user behaviour - Vehicular characteristics. Traffic Surveys: Speed, Journey time and delay study – Methods-Moving observer method, Presentation of data- grouping of speed data, cumulative frequency curve, problems. Vehicle volume counts and classifications – methods, OD surveys, Parking surveys.

Module – II

Traffic and Intersection Controls: Different types of traffic signs and markings, Types of intersections, Design considerations, Conflict areas at intersections, Traffic control devices, Warrants for installing traffic signal, Traffic signal- types and design, Warrants for interchanges, types of interchanges.

Module – III

Traffic Safety: Accidents-causes and prevention. Parking: Terminologies associated with parking studies, types of parking. Traffic Management-Concept and techniques, Specific traffic management measures like bus only lane. Street Lighting - Necessity, methods, arrangement - at carriageways, T, rotary, bend, bridge, tunnels. ITS, GIS and GPS - Introduction to Intelligent Transportation Systems, Geographic Information System and Global Positioning System and its application.

Module – IV

Traffic variables and traffic flow theory (time-mean and space-mean speed, traffic flow and density, headways and spacing, fundamental diagram). Concept and definition of Passenger Car Unit, Introduction to Highway capacity, Level of service, Factors affecting capacity and level of service. Basic freeway capacity, Two lane highway capacities, Multilane highway capacity, capacity of weaving sections, capacity of rotary.

References:

1. Adolf D. May, *Traffic Flow fundamentals*.
2. Mcshane and Roess, *Traffic Engineering.*
3. L. R. Kadyali, *Traffic Engineering and Transport Planning*.

4. Roess R., E. Prassas and W. Mc Shane, *Traffic Engineering*, 3/e, Prentice Hall, 2004.
5. Patha Chakraborty and Animesh Das. *Principles of Transportation Engineering*.
6. Relevant IRC Codes

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

O*n successfully completing this course, students will possess a good understanding of traffic engineering; know basic quantitative methods required by traffic engineers and the consequences for traffic engineering.*

13.806.8 VALUATION OF REAL PROPERTIES (C) (Elective IV)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To understand the basic principles, methods and requirements of valuation of real properties*
- *To understand different types of depreciation and calculation, and how to use them in valuation process*
- *To understand rent fixation procedure for public and private buildings*
- *To prepare valuation reports in legal formats.*

Module – I

Basic principles of valuation- Cost price and value- kinds of properties-Different purposes of valuation- kinds of values and definition-Factors affecting the value in general-Sources of valuation. Depreciation –Types, Methods of calculating depreciation- Obsolescence Replacement value- Depreciation value.

Module – II

Different methods of Valuation - Market value, Guideline values, FSI and plot coverage, Land locked land, Recess land. Valuation of land - Valuation by belting method, Valuation land and building method, Valuation of flats - Composite rate method. - Case studies.

Module – III

Valuation for banks- Different purposes-Collateral security and primary security- Mortgage - lease – easement

Valuation of commercial complex-Rent capitalization method- Valuation for - Rent fixation, taxation-Income tax, wealth tax, capital gain-Probate.

Module – IV

Procedure to become a valuer, Legal aspects of valuation, Valuation formats, Report writing procedure.

Preparing valuation reports in legal formats considering market / fare and distressed values using rental /sinking fund/ depreciation methods. Case studies.

References:

1. Rangwala S. C., *Valuation of Real Properties*, Charotar Publishing House Pvt. Ltd., 2008.
2. Chakraborty M., *Estimating, Costing and Specifications in Civil Engineering*, USB publishers and Distributors Ltd., New Delhi, 2012.

3. Duglas Scarrett, *Property Valuation: The Five Methods*, Taylor and Francis, 2010.
4. Banerjee D. N., *Park's Valuation,* 5/e, Eastern Law House, Calcutta, 1998.
5. Namavati R. H., *Theory and Practice of Valuation*, Lakhani Book Depot, Bombay, 1998.
6. Ashok Nain, *Professional Valuation Practice*, Tata McGraw Hill, New Delhi, 1997.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *No charts, tables, codes are permitted in the Examination hall .If necessary relevant data shall be given along with the question paper by the question paper setter.*

Course outcome:

After successful completion of the course, the students will be able to:

- *To calculate the depreciation and hence the depreciated cost or value of any property.*
- *To fix the rent for public and private buildings.*
- *To prepare valuation reports in legal format.*

13.806.9 DESIGN OF PORT, HARBOUR AND COASTAL STRUCTURES (C)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *To impart basic knowledge in civil engineering aspects of Ports and Harbours.*
- *To familiarize the students in the areas of design aspects of port structures.*

Module – I

The fundamentals: Wave conditions inside harbour, water circulation; breakwaters, jetties and quay walls; mooring, berthing and ship motion inside the port; Cargo handling – bulk material storage and handling.
Loads on Wharfs, Jetties, Dolphins. Live Load for different classes of Cargo - Dead load, Wind/ wave loads, Loads due to Crane Lateral loads Mooring & Berthing forces - fenders - Bollards

Module – II

Shore Protection Structures - Principles of design of sea walls, dikes, Groin fields, detached breakwaters. Artificial beach nourishment. Soft methods of coastal protection Littoral drift - effect of manmade structures on the natural littoral drift. Methods for overcoming imbalance of littoral drift. Sand bypassing groins. Environmental Impact studies.

Module – III

Breakwaters - Type and selection Criteria. Assessment of design input conditions. Environmental force. stability criteria. Design of Rubble mound, Caisson type, Vertical wall type**.** Different types of Armour units.

Module – IV

Design of port infrastructures with regards to (1) Cargo handling (2) Cargo storage (3) Integrated transport of goods, Planning multipurpose port terminals.

References

1. Oza H. P. and G. H. Oza, *Dock and Harbour Engineering,* 6/e, Charotar Books, Anand., 2011.
2. Seetharaman S., *Construction Engineering and Management*, 4/e, Umesh Publications, New Delhi, 1999
3. Richand L. Silister, *Coastal Engineering Volume I & II,* Elsevier Publishers, 2000.
4. Brunn, P., *Port Engineering*, 1/e, Gulf Publishing Company, 2001.
5. *Shore Protection Manual*, Vol. I &II, Costal Engineering Research Centre
6. Aionzo F. Quinn, *Design and Construction of Ports and Marine Structures,* McGraw Hill Book Company, 1972.

7. Thoresen C. A., *Port Design - Guidelines and Recommendations,* Tapir Publications.
8. Gaythwait J. W*., Design of Marine Facilities for the Berthing, Mooring and Repair of Vessels,* Van Nostrand.
9. Chakrabarti S. K., *Handbook of Offshore Engineering,* Elsevier, 2005.
10. Agerschou, H., Lundgren, H., Sorensen, T., Ernst, T., Korsgaard, J., Schmidt, L.R. and Chi, W.K., *Planning and Design of Ports and Marine Terminals*, A Wiley-Interscience Publication, 1983.
11. Arthar, T. Ippen, *Estuary and Coastline Hydrodynamics* , McGraw Hill Book Co., 1964
12. Henry F. Cornik, *Dock and Harbour Engineering Vol.–I to IV*, Charles Griffin & Company Ltd. London, 1988.
13. Robert M. Sorensen, *Basic Coastal Engineering*, Springer, 2006.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *No charts, tables, codes are permitted in the Examination hall. If necessary the same shall be given along with the question paper by the question paper setter.*

Course outcome:

After successful completion of the course, the students will be able to:

- *Understand wave theory, break water and various forces acting on coastal structures.*
- *Plan and design groynes, sea wall, harbour and offshore structures.*

13.807 PROJECT AND VIVA-VOCE (C)

Teaching Scheme: 0(L) - 0(T) - 5(P) **Credits**: 5

Course Objective :

- *To provide motivation for the students to solve real world problems using mathematics and engineering principles.*
- *To motivate students to participate in group discussions and thereby exchange ideas.*
- *To serve as platform to identify research issues in existing systems.*
- *To impart the ability for project planning and also to develop the skill of implementing the ideas generated from the curricular components.*

The project is aimed at improving the professional skill and competency of the students. Students groups may be formed with not more than five students in a group. Each group is expected to select a project in one of the current topics in Civil Engineering. A detailed project report in soft bound in an approved format is to be submitted at the end of the semester.

The performance of the students in the project work shall be assessed on a continuous basis by a panel consisting of the project coordinator, project guide, and two faculty members of the relevant subject group/ specialization. The project coordinator shall be the chairman of the panel.

There shall be at least an interim evaluation and a final evaluation of the project work. Each student in the group may give a power point presentation on the project work during the evaluation process. For the award of the sessional marks, the project report and the power point presentation of the project work shall be assessed. The students may be assessed individually and in groups.

Internal Continuous Assessment *(Maximum Marks-200)*

Marks for interim evaluation – 25%

Marks for final evaluation – 25%

Marks to be awarded by the project guide – 50%

The interim evaluation should be based on following criteria:

20%- Current relevance of the work, novelty and innovation, etc.

30%- Review of Literature and awareness to the work/topic

20% - Problem statement & Methodology

30% - Progress of the project - Implementation/experimentation of the work

The final evaluation should be based on following criteria:

25% - Involvement in the work

50% - Results & Quality of the project

25% - Project Presentation/ Demonstration

The mark awarded by the guide should be based on the following criteria:

25% - Subject knowledge

35%- Actual work (Applying subject knowledge to the work and putting research effort)

10% - Regularity in the class and active participation in discussions

10% - Team work

10%- Communication and documentation skills

10%- Project Report

University Examination Pattern:

Viva Voce *Maximum Total Marks: 100*

Marks should be awarded as follows:

General topics covering Civil Engineering and other related/ advanced topics.	*- 50%*
Project work	*- 35%*
Seminar/ Survey camp/ Industrial visit	*- 15%*

Course Outcome:

After successful completion of this course, the students will be able to:

- *Apply knowledge of mathematics, science and engineering principles to solve complex real world problems bringing out economically and socially feasible solutions upholding ethical values.*
- *Participate in peer group discussions and integrate ideas.*
- *Apply the knowledge base about advanced topics pertaining to area of study to design and implement solutions to challenging problems.*
- *Identify new research problems from issues raised during implementation.*
- *Communicate problems and solutions to society through reports.*
- *Manage time and resources effectively.*