UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VII SEMESTER

CIVIL ENGINEERING

SCHEME -2013

VII 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				
13.701	Design of Steel Structures (C)	5	3	2	-	50	3	100	150
13.702	Design and Drawing of Reinforced concrete structures (C)	5	3	-	2	50	4	150	200
13.703	Advanced Structural Analysis (C)	4	2	2	-	50	3	100	150
13.704	Elective – I	4	3	1	-	50	3	100	150
13.705	Elective – II	4	3	1	-	50	3	100	150
13.706	Environmental Engineering Lab. (C)	2	-	-	2	50	3	100	150
13.707	Geotechnical Engineering Lab. (C)	2	-	-	2	50	3	100	150
13.708	(a) Seminar (b) Survey Camp & Industrial Visit	3	-	-	3	150			150
	Total	**29**	**14**	**6**	**9**	**500**		**750**	**1250**

ELECTIVE -I

13.704.1	Structural Analysis for Dynamic Loads (C)
13.704.2	Advanced Design of Reinforced Concrete Structures (C)
13.704.3	Earth dam Engineering (C)
13.704.4	Soil Exploration (C)
13.704.5	Geoinformatics (C)
13.704.6	Free Surface Flow (C)
13.704.7	Air Quality Management (C)
13.704.8	Highway and Airfield Pavement Materials (C)
13.704.9	Sustainable Development (C)
13.704.10	Coastal Engineering (C)
13.704.11	Environmental Science and Management (C)
13.704.12	Modern Construction Materials (C)

ELECTIVE -II

13.705.1	Pre-stressed Concrete (C)
13.705.2	Mechanics of Composite Materials (C)
13.705.3	Ground Improvement (C)
13.705.4	Geo Environmental Engineering (C)
13.705.5	Ground Water Engineering (C)
13.705.6	Solid Waste Management (C)
13.705.7	Transportation Planning (C)
13.705.8	Advanced Computational Methods (C)
13.705.9	Optimization Techniques in Engineering (C)
13.705.10	Design of Offshore Structures (C)
13.705.11	Transportation System Management (C)

13.701 DESIGN OF STEEL STRUCTURES (C)

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

Course Objectives:

- *To introduce steel as a structural material and various design philosophies applicable to steel structures.*
- *To impart knowledge about the fundamentals of analysis and design of steel structural members.*
- *To develop fundamental knowledge in plastic analysis of steel structures.*

Module – I

Properties of structural steel, Structural steel sections, Limit state and working stress design concepts, Types of connections - Design of welded and bolted connections, design of bolted connections using high strength friction grip bolts.

Design of tension members and their connections, Lug angle connection design. Design of struts (single angle and double angle sections).

Module – II

Design of laterally supported and unsupported beams - Built up beams, Simple beam to column connections (bolted and welded connections).

Plate girders- design of section, curtailment of flange plate, bearing and intermediate stiffeners, connections, flange and web splices, Gantry girders (only design concept).

Module – III

Columns- Design of axially and eccentrically loaded compression members, simple and built up sections, lacing and battening.

Column bases- slab bases and gusseted bases.

Module – IV

Light gauge steel structures – Types of sections, Flat width ratio, Buckling of thin elements, Effective design width, Form factor, Design of tension, compression members and beams.

Plastic design- basic assumptions - shape factor, load factor- Redistribution of moments - - upper bound, lower bound and uniqueness theorems- analysis of simple and continuous beams, two span continuous beams and simple frames by plastic theory - static and kinematic methods.

References:

1. Subramanian N., *Design of Steel Structures*, Oxford University Press, 2008.
2. Arya A.S. and J. L. Ajmani, *Design of Steel Structures*, Nemchand & Bros, 1996.
3. Dayaratnam P*., Design of Steel Structures*, Wheeler Publishers, 2007.
4. Ramachandra, *Design of Steel Structures*, Standard books, 2011.
5. Duggal S.K., *Design of Steel Structures*, Tata McGraw Hill, 2000.
6. IS. Codes: IS:800-2007, IS:811-1987, IS:801- 1975.

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 carries 20 marks.

Note: Use of IS. Codes (IS:800-2007, IS:811-1987, IS:801- 1975) *and Structural Steel Tables are permitted in examination halls.*

Course Outcome:

The students after undergoing this course will have the

- *Capability to design structural members using relevant IS codes and steel tables.*
- *Ability to analyse the strength of structural elements.*
- *Ability to analyse statically indeterminate structures plastic moment.*

13.702 DESIGN AND DRAWING OF REINFORCED CONCRETE STRUCTURES (C)

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

Course Objectives:

- *To give an idea about the different type of retaining walls, water tanks, bridges, flat slabs ribbed slabs and, their components.*
- *Provide an understanding in analysis and design of retaining walls, water tanks, bridges and flat slabs based on relevant codal provisions.*
- *To give an idea to develop structural detailing of retaining walls, water tanks, bridges and flat slabs.*

Module – I

Structural behaviour of different type of retaining walls. Design of retaining walls – Limit State method - cantilever and counterfort retaining walls with horizontal and inclined surcharge.

Water tanks – design of circular and rectangular water tanks at ground level and overhead, complete design excluding supporting structure – design of domes for circular water tanks.

Drawing and detailing of structures designed.

Module – II

Road Bridges – IRC specifications – Class A, Class AA loading – Design of slab bridges, T-beam and slab bridges - Design principles of Pre-stressed concrete bridges.

Flat slabs – analysis of flat slab – direct design method – principles of equivalent frame method – design of interior flat slabs for flexure and shear –Discussion on the design of exterior flat slab - Ribbed slab and the design principles

Drawing and detailing of structures designed.

References:

1. Varghese P.C., *Limit State Design of Reinforced Concrete*, Prentice Hall of India Ltd., 2015.
2. Krishnaraju N., *Structural Design and Drawing - Reinforced Concrete and Steel*, Universities Press Ltd., 2009.
3. Jain A. K., *Reinforced Concrete Limit State Design*, Nem Chand Brothers, Roorkee, 2012.
4. Unnikrishna Pillai and Devdas Menon, *Reinforced Concrete Design*, Tata McGraw-Hill, 2010.
5. Sinha S. N., *Reinforced Concrete Design* Tata McGraw Hill, 2002.
6. Krishnaraju N., *Prestressed Concrete*, Tata McGraw Hill, 2007.

7. Mehra H. and V. N. Vazirani, *Limit State Design*, Khanna Publishers, 2007.
8. Krishnaraju N., *Design of Bridges*, Universities Press Ltd., 2010.
9. Johnson V., *Essentials of Bridge Engineering,* Oxford and IBH, 2009.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Tests (minimum 2)

40% - Class work, Drawings and Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

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 456:2000; IS 3370 (Parts I- IV), IRC 6 & 21 and Design charts are permitted in the examination hall.*

Course Outcome:

The students after undergoing this course will have

- *Capability to analyse and design retaining walls, water tanks, bridges and flat slabs using relevant IS codes and SP16.*
- *Ability to present structural detailing of retaining walls, water tanks, bridges and flat slabs.*

13.703 ADVANCED STRUCTURAL ANALYSIS (C)

Teaching Scheme: 2(L) - 2(T) - 0(P) **Credits**: 4

Course Objectives:

- *To introduce matrix methods of analysis and basics of finite element analysis.*
- *To equip the students with a thorough understanding of the laws underlying the mechanics of structures in the mathematical framework of matrices.*
- *To provide a bridge between traditional methods and modern computer aided methods of analysis.*

Module – I

Introduction to matrix analysis of structures – Concept of flexibility and stiffness influence coefficient- Concept of development of stiffness matrix and flexibility matrix by physical approach – Equivalent joint loads - Concept of element approach – Stiffness method by element approach - Development of compatibility matrix – Element stiffness matrices for truss, beam and plane frame elements - Development of structure stiffness matrix by element approach – Analysis of statically indeterminate beams, rigid jointed and pin-jointed plane frames by stiffness matrix approach.

Module – II

Concept of direct stiffness method – Transformation of element stiffness matrices from local to global co-ordinates – Application of direct stiffness method to two span continuous beams and pin-jointed plane frames (frames of maximum three members) - Advantages of direct stiffness method.

Flexibility method by element approach – Development of equilibrium matrix – Element flexibility matrices for truss, beam and plane frame elements - Development of structure flexibility matrix by element approach – Evaluation of displacements in statically determinate beams, rigid jointed and pin-jointed plane frames by flexibility matrix approach.

Module – III

Analysis of statically indeterminate beams, rigid jointed and pin-jointed plane frames by flexibility matrix approach. Comparison of flexibility matrix and stiffness matrix methods.

Module – IV

Introduction to finite element analysis – Concept of discretization of continuum - Finite element analysis procedure – Relevant basics of elasticity – Stress-strain relation (Constitutive relation) - Strain-displacement relation – Concept of strain-displacement matrix – Types of 1-D, 2-D and 3-D finite elements –

Plane stress and plane strain problems – Displacement function – Convergence and compatibility requirements - Development of shape functions for truss element (2-noded and 3-noded), beam element and CST element – Derivation of expressions for element stiffness matrix and nodal load vector (Derivation of equilibrium equation) – Development of stiffness matrix for truss element alone.

References

1. William Weaver Jr. and James M. Gere, *Matrix Analysis of Framed Structures*, CBS Publishers, New Delhi.
2. Pandit G. S. and Gupta S. P., *Structural Analysis – A Matrix Approach*, Tata McGraw Hill, New Delhi.
3. Rajasekharan S. and G. Sankarasubramanian, *Computational Structural Mechanics*, Prentice Hall of India, New Delhi.
4. Hibbeler R. C., *Structural Analysis*, Pearson Education, New Delhi.
5. Ghali A., Neville A. M. And Brown T. G., *Structural Analysis – A Unified Classical and Matrix Approach*, Spoon Press, London and New York.
6. Manicka Selvam V.K., *Elements of Matrix and Stability Analysis of Structures*, Khanna Publishers, Delhi, 2010.
7. Cook R.D., *Concepts and Applications of Finite Element Analysis*, John Wiley & Sons.
8. Krishnamoorthy C. S., *Finite Element Analysis – Theory and programming*, Tata McGraw Hill, New Delhi.
9. Rajasekharan S., *Finite Element Analysis in Engineering Design*, Wheeler Publishers.
10. Chandrapatla T. R. and A. D. Belegundu, *Introduction to Finite Elements in Engineering*, 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:

- *Understand what happens behind the black box of the software package commonly used for structural analysis*
- *Check the results generated by the computer output*
- *Face the analysis of challenging structural systems confidently.*

13.704.1 STRUCTURAL ANALYSIS FOR DYNAMIC LOADS (C) (Elective I)

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

Course Objective:

- *To understand the behaviour of structures under dynamic loads*
- *To provide understanding of basic dynamic analysis procedures and seismic force calculations.*

Module – I

Review of analysis of dynamic systems – parameters, Dynamic loading, D'Alembert's principle - Single degree of freedom (SDOF) systems, Equation of motion, Natural frequency, Free and forced vibration- Modelling of SDOF systems.

Response of SDOF system subjected to harmonic loads – steady state and transient states – steady sate amplitude – Dynamic magnification factor. Evaluation of damping ratio – Half power (band-width) method.

Module – II

SDOF systems subjected to support motion. Vibration isolation – Transmissibility.

Response to impulsive loading – half sine, rectangular and triangular impulses. Impulse response function, Response of SDOF systems subjected to general dynamic loading – Duhamel integral.

Module – III

Multi-degree of freedom (MDOF) systems, Modelling - Lumped mass and consistent mass, Shear building frames, Equation of motion of MDOF systems, Natural frequencies and mode shapes, Orthogonality of normal modes, Forced vibration analysis - Mode superposition method.

Module – IV

Distributed parameter systems, Differential equation – beam flexure (elementary case), Natural frequencies and mode shapes of simply supported beams.

Introduction to earthquake analysis – response spectrum, Response spectrum analysis of MDOF system subjected to support motion.

Calculation of design seismic forces in building frames using IS:1893-2002 (Equivalent lateral force method only).

References:

1) Mario Paz, *Structural Dynamics*, CBS Publishers, New Delhi, India, 2001.

2) Clough R. W. and J. Penzien, Dynamics of Structures, McGraw Hill, 1993.
3) Chopra A. K., *Dynamics of Structures- Theory and application to Earthquake Engineering*, Pearson Education India, 2007.
4) Biggs J. M., *Introduction to Structural Dynamics*, McGraw-Hill Book Inc., New York, 1964.
5) Mukhopadhyay M., *Vibrations, Dynamics and Structural Systems*, Taylor & Francis, London, 2000.
6) Manicka Selvam V. K., *Elementary Structural Dynamics*, Dhanapat Rai Publications, New Delhi, India, 2001.
7) IS:1893-2002, Criteria for earthquake Resistant Design of structures.

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 :2002 is allowed in the examination.*

Course Outcome:

After successful completion of the course, the students will have awareness of the dynamic response of structures. They will be able to apply engineering knowledge to model dynamic systems and obtain their response due to dynamic loads.

13.704.2 ADVANCED DESIGN OF REINFORCED CONCRETE STRUCTURES (C) (Elective I)

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

Course Objective:

To give an in-depth idea regarding the advanced theoretical knowledge of reinforced concrete structure giving importance to those areas which are not covered in the basic RCC design of structures subject.

Module – I

Advanced theory in stress- strain characteristics of concrete under uni-axial and multiaxial states of stress, confined concrete, effect of cyclic loading on concrete and reinforcing steel. Design concepts – limit state method – comparison of different codal regulations.[American, British, Euro code & Indian].

Module – II

Behaviour and design of reinforced concrete members in flexure, flexural shear- Analysis and design of compression member – slender columns, including biaxial bending. Serviceability limit states- estimation of deflection, immediate and long term deflection, control of cracking, estimation of crack width in RC members –codal procedures on crack width computations.

Module – III

Design of special RC members-Analysis of shear walls- distribution of lateral loads in uncoupled shear walls, Design of concrete corbels.

Module – IV

Design of ribbed slabs, deep beams, pile caps. Yield line analysis of slab, yield line mechanisms- equilibrium and virtual work method.

References:

1. Hong F.K. & Evans R.H., *Reinforced and Pre-stressed concrete,* Taylor and Francis
2. Clien W. F., *Plasticity on Reinforced concrete*
3. Park P. and T. Paulay, *Reinforced concrete Structures,* Wiley and Sons.
4. James M. F., C*oncrete Engineering Hand book,* McGraw Hill
5. Ramakrishna and Arthur, *Ultimate Strength Design for Structural Concrete.*
6. Purushothaman P., *Reinforced concrete Structural Elementary,* Tata McGraw Hill Company Ltd., New Delhi.
7. Varghese P. C., Advanced *Reinforced Concrete Design,* 2/e, PHI Learning Pvt. Ltd.

8. Bhavikatti S., *Advance RCC Design [Volume II],* New Age International.

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 456 :2000 and SP: 16 Charts are allowed in the examination.*

Course Outcome:

The students after taking this course will be able to analyse the complicated behaviour of concrete structures and will be able to design special RCC structures.

13.704.3 EARTH DAM ENGINEERING (C) (Elective I)

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

Course Objective:

To impart to the students the fundamentals of Earth and Rock fill dams; To enable students to acquire proper knowledge regarding the design and analysis aspects of earth and rock fill dam Engineering.

Module – I

Earth Dam – Requirements of foundation – Materials of construction – Design to suit the available materials – Embankment construction – Methods of placement and compaction – Compaction control – Placement water content.

Module – II

Seepage through dams – Determination of phreatic line – Casagrande's solution- Kozheny's parabola-Entrance & Exit correction –Flownets for homogenous earth dams-Flownets for dams under steady seepage and sudden draw down conditions- Control of seepage – Adverse effects of seepage- Liquefaction and its prevention- Methods of reducing seepage – Selection of core types – Cut off trenches – Grout curtains- Sheet pile walls – Upstream blanket – relief walls.

Module – III

Stability Analysis – Role of pore pressure in stability analysis – pore pressure during construction, steady seepage & sudden drawdown conditions – Instrumentation of earth dams.

Module – IV

Rockfill dams- General characteristics – Impervious membrane and earth cores – Control of rock fill placement – Settlement of rockfill.

References:

1. Sherard, Woodward, Gizienzki and Clevenger, *Earth and Earth-Rock Dams*, John Wiley and Sons, New York, 1963.
2. Bharat Singh and Punmia, Earth and Rockfill Dams, Standard Publishers and Distributors, New Delhi, 1988.

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 the course the student understands the basic principles governing the design of earth and Rock fill dams and also they acquires the ability to understand the applicability and limitations of various design methods.

13.704.4 SOIL EXPLORATION (C) (Elective I)

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

Course Objective:

- *To impart to the students, a clear idea about how a geotechnical investigation programme is to be planned and executed.*
- *To impart in-depth knowledge about the various methods of geotechnical investigation and the field tests to be conducted in different situations*.

Module – I

Objectives of soil exploration – Planning of a sub-surface exploration programme – Collection of existing information, reconnaissance, preliminary and Detailed investigation - Number, size, spacing and depth of boreholes –Methods of exploration - Open pits – Auger boring, wash boring, percussion drilling, rotary drilling – Comparison of the methods - Stabilization of boreholes. Plate load test – Procedure, uses and limitations – Solution of numerical problems using plate load test data.

Module – II

Sounding methods – Standard Penetration Test – Procedure – corrections to be applied to observed N values – Procedure for estimation of representative average N value – Numerical examples - Factors influencing the SPT results and precautions to obtain reliable results – Merits/drawbacks of the test – Correlations of N value with various engineering and index properties of soils. Static Cone Penetration Test – Procedure – Merits/drawbacks – Correlation of static CPT results with soil properties - Dynamic Cone Penetration Test – Procedure – Merits/drawbacks – Critical comparison of SPT, static CPT and dynamic CPT
Pressure meter test - Procedure –Uses – The borehole shear test – Procedure- Uses.

Module – III

Geophysical methods – Seismic refraction method – Procedure, uses, limitations – Solution of numerical problems to estimate the velocity of seismic waves and the thickness of upper layer of a two-layered soil system - Electrical resistivity method – Electrical profiling and electrical sounding – Procedure, uses, limitations . Cyclic pile load test –Procedure for separation of end bearing and skin friction resistance- solution of numerical problems using cyclic pile load test data - Determination of field permeability by pumping out test [no derivation required].

Module – IV

Soil sampling – Undisturbed, disturbed, and representative samples – Chunk and tube samples – Factors affecting sample disturbance and methods to minimise them – Significance of Area ratio, Inside clearance, Outside clearance and Recovery ratio –

Numerical problems to assess the quality of a sampler - Use of Ball check valve – Handling and transportation of samples – Extrusion of samples . Types of samplers – Thin walled sampler – Piston sampler – Split spoon sampler - Core retainers – Types of drill bits – Rock Quality Designation –Bore log – Soil profile – Sub-soil investigation report.

References:

1. Joseph E. Bowles, *Foundation Analysis and Design*, Mc. Graw Hill Inc., New York, 1988.
2. Peck B., Hansen and Thornborn, *Foundation Engineering*, John Wiley & Sons, New York, 1947.
3. Gopal Ranjan and A. S. R. Rao, *Basic and Applied Soil Mechanics*, New Age International (P) Limited, New Delhi, 2002.
4. Arora K. R., *Geotechnical Engineering*, Standard Publishers Distributors, New Delhi, 2006.
5. Venkataramaiah, *Geotechnical Engineering*, Universities Press (India) Limited, Hyderabad, 2000.

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 understand the procedure, applicability and limitations of various methods of geotechnical investigation; Ability of the students in making proper engineering judgements and in taking appropriate decisions related to geotechnical investigations is greatly improved.

13.704.5 GEOINFORMATICS (C) (Elective I)

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

Course Objective:

- *To impart a basic knowledge on geospatial data and its importance in infrastructure development and resource management.*
- *To familiarize the different geospatial data acquisition systems like GPS, remote sensing and geospatial data analysis platforms like GIS.*

Module – I

Shape of Earth, Topography, Geoid, Ellipsoid. Geographic coordinate systems - Datum: WGS 84 Datum and Everest Datum. Projected coordinate systems- Map projections: Types of Map projections, Map projection parameters- UTM projection. Methods of representation of Relief, TIN data and Grid Data.

Module – II

GPS Basics- system overview-working principle of GPS-Satellite ranging-calculating position-Ranging errors and its correction-code phase and carrier phase measurements - GPS Surveying methods-Static, Rapid static , Kinematic methods - Real time and post processing DGPS- GPS Survey planning and observation-horizontal and vertical control - GPS data processing- Applications of GPS.

Module – III

Remote Sensing : Definition- Electromagnetic spectrum-Energy interactions with atmosphere and earth surface features-spectral reflectance of vegetation, soil and water-Classification of sensors-spatial resolution-spectral resolution-radiometric resolution-Temporal resolution- Optical and Infra-red sensors-Active and Passive sensors-Multi spectral scanning-Along track and across track scanning, IRS LISS Camera- Thermal and Microwave sensing (brief description only)-Visual Image Interpretation –Indian Remote Sensing System.

Module – IV

Fundamentals of GIS: Definition-components of GIS - GIS operations - Spatial data modelling - Raster and vector data representation - Data Input methods - Geometric Transformation - RMS error, Vector data Analysis - buffering, overlay, Modelling surfaces-DTM, Triangulated irregular network (brief description only)-GIS output.

References:

1. Barry F. K., *Geomatics*, Pearson Education Ltd.
2. Iliffe, C.J., *Datums and Map Projections for Remote Sensing, GIS and Surveying*, Whittles Publishing.

3. Satheesh Gopi, *The Global Positioning System and Surveying*, Pearson Education
4. Lillesand M. and W. Kiefer, Remote Sensing and Image Interpretation, John Wiley and Sons.
5. George Joseph, *Fundamentals of Remote Sensing*, University Press.
6. Anji Reddy M., *Remote sensing and Geographical Information Systems*, B S Publications, Hyderabad.
7. Kang-Tsung Chang, *Introduction to Geographic Information Systems*, Tata McGraw Hill.
8. Burrough P., *Principles of Geographical Information Systems*, Oxford University Press.

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 benefited by the knowledge of recent geo information technologies.

13.704.6 FREE SURFACE FLOW (C) (Elective I)

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

Course Objective:

- *Apply conservation of mass, momentum and energy principles to open channel flow problems*
- *Design channels using the concepts of uniform flow and gradually varied flow conditions*
- *Introduce the principles of unsteady one-dimensional flows in open channel problems*

- *The course is designed to give the engineering student a solid understanding of open channel hydraulics, particularly in steady, gradually varied flow, spatially varied flow and a basis for the design of free surface systems..*

Module – I

Open channel flow-Velocity and pressure distribution-energy and momentum correction factors-Pressure distribution in curvilinear flows. Energy and momentum principle-critical flow, Application of specific energy principle to channel transitions with hump or change in width, specific force, Uniform flow- composite sections, Hydraulic exponents N and M-computation of uniform flow.

Module – II

Design of channels for uniform flow, Non-erodible channels – minimum permissible velocity, best hydraulic section, Erodible channels with scour but do not silt-tractive force and permissible velocity approach- stable hydraulic section.

Module – III

Varied Flow: Dynamic equations of gradually varied flow, assumptions and characteristics of flow profiles, classification of flow profile, draw down and back water curves, profile determination, graphical integration, direct step and standard step method, numerical methods, flow through transitions.

Module – IV

Rapidly Varied Flow: Hydraulic Jumps- Hydraulic jumps in non rectangular channels, exponential channels, basic characteristics of jump, length and location of jump, jump as energy dissipation, control of jump, design of stilling basins, Ogee Spillway- uncontrolled crests- profile, Standing wave flume, Parshall flume. Rapidly varied unsteady flow – surges. Spatially varied flow, dynamic equation of spatially varied flow, Analysis of spatially varied flow profile.

References:

1. Ven Te Chow, *Open Channel Hydraulics*, Tata McGraw Hill Book Co
2. Subramanya K., *Flow in Open Channels*, Tata McGraw Hill Series.
3. Ranga Raju, *Flow through Open Channels*, Tata McGraw Hill.
4. Hanif Chaudhary M., *Open Channel Flow*, Prentice Hall India Private Ltd.
5. Henderson F. M., *Open Channel Flow*, McMillan, New York.

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 capable of understanding the basic principles of open channel hydraulics and applying them in solving practical flow problems relating to open channel flows.

13.704.7 AIR QUALITY MANAGEMENT (C) (Elective I)

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

Course Objective:

- *To understand the basic principles of air quality management*
- *To understand various engineering concepts involved in control and regulation of air pollution.*

Module – I

Definition-Sources- Classification of air pollutants- Nature of air pollution problems-Nature of pollutants. Industrial processes causing air pollution. Effects of pollutants on health, vegetation, materials & atmosphere - Behavior and fate of air pollutions.

Air quality standards and legislation: - Ambient air quality standards, air quality emission standards, air pollution control legislation.

Module – II

Meteorology & Dispersion of pollutants: Stability, Inversions, Diffusion of pollutants, Air quality modeling, Approach to model formulation, Dispersion models. Air pollution indices: Economics & new trends of air pollution control.

Module – III

Air sampling and analysis of air pollutants: Principles and instruments for pollution control; Ambient air quality & emission standards, Indoor pollution, Sampling train for ambient air sampling and stack sampling, particulate and gas analysis.

Module – IV

Control of air pollutants**:** Particulate emission control, Gaseous emission control, Biological air pollution control techniques, Bio-scrubbers, Removal of gaseous pollutants. Different methods, Adsorption, Absorption, Condensation, Incineration, Automobile pollutants, control of automobile emissions.

References:

1. Stern A., *Air pollution,* Vol. 1, 2 & 3, Academic Press, New York.
2. Rao C. S*., Environmental pollution control Engineering,* Wiley Eastern Ltd, Delhi.
3. Rao M. N. and H. V. N. Rao*, Air Pollution,* Tata McGraw Hill Co. Ltd, Delhi.
4. Wayne R Ott*, Environmental Indices, Theory and practices,* Ann Arbor Science Publishing Company. Inc.
5. Beat Meyer*, Indoor Air Quality,* Addison – Wesley Publishers.

6. Chhatwal G. R.*, Encyclopedia of Environmental Pollution and Control,* Vol. 1, 2 & 3, Anmol Publications.
7. Noel de Nevers*, Air Pollution Control Engineering,* McGraw Hill, New York, 1995.

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 significance, need and methods of air quality management programs.

13.704.8 HIGHWAY AND AIRFIELD PAVEMENT MATERIALS (C) (Elective I)

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

Course Objective:

- *To understand the characteristics and tests of flexible and rigid pavements materials.*
- *To study recent developments in construction practices and modern equipments used.*

Module – I

Characterization of subgrade soil, Properties and test for use as subgrade material. Soil classification systems regarding suitability as subgrade soil. Soil stabilization methods - Chemical and Mechanical and their construction procedures. .Road aggregates- Properties and tests. Bitumen- Manufacturing, Grading and tests. Emulsions, Cut backs and Modified binders-Properties, types and uses.

Module – II

Bituminous pavement types:-Penetration layer systems and Pre mixed aggregate and bituminous mixtures. Mix Design- Marshall method and Superpave procedure. Construction of bituminous pavements- Preparation and construction of Base, Sub base and surface layers including equipments.

Module – III

Material characterization for Cement concrete pavements- Properties and tests for the materials used for CC pavements. Construction of Cement concrete pavements – Preparation of Subgrade and Base, Presetting reinforcements in joints and PCC slab construction stages. Thin white topping and ultra thin white toppings.

Module – IV

Specialised applications of materials and construction practices- Interlocking concrete block pavements – Materials used and the construction procedures. Geo-Textiles- Types and functions as pavement material. Introduction to Microsurfacing, Porous pavements, Warm mix asphalt & Recycling of pavements.

References:

1. Wright P. H. and K. Dixon, *Highway Engineering,* John Wiley & Sons, 1996.
2. Mallick R. B. and T. E. Korchi, *Pavement Engineering,* CRC Press, 2009.
3. Manual for Construction and Supervision of Bituminous Works, MoRTH , 2001.
4. IRC SP: 63-2004, *Guidelines for Use of Interlocking Concrete Block Pavement*, Indian Roads Congress.

5. G.V. Rao, P. K. Banerjee, J. T. Shahu, G. V. Ramana, *Geosynthetics -New Horizons*, Asian Books Private Ltd., New Delhi, 2004.
6. Khanna S. K. and C. E. G. Justo, Highway Material Testing, New Chand & Bros., 1999.

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 understand the need for tests and procedures adopted for construction. To equip the students with practical sense of road construction using suitable materials

13.704.9 SUSTAINABLE DEVELOPMENT (C) (Elective I)

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

Course Objective:

- *To understand and familiarise with the concept of Sustainable Development.*
- *To learn about sustainable building materials and construction.*
- *To learn about energy efficient material and construction.*
- *To learn about waste reduction in construction industry.*

Module – I

Concepts of sustainability : Energy and Global environment, Energy use and Climate change – Its impact, Types of Energy systems, Concept of Sustainability - Principles of conservation - synergy with nature, Bioregionalism - community basis shelter technology within bioregional patterns and scales, Ethical- environmental degradation.

Module – II

Sustainable Building Materials: Properties, Uses and Examples of -Primary, secondary and Tertiary Sustainable Materials. Principles to improve the energy efficiency - siting and vernacular design, shade, ventilation, earth, shelter, thermal inertia and air lock entrances; solar water heating panels; photovoltaic electricity generation.

Module – III

Techniques of sustainable construction - technologies, methods of effectiveness, and design synthesis – Green buildings - alternative materials and construction methods: use of local materials and on site growth of food, fuel and building materials.

Module – IV

Recycling and Reuse : Pre building, Building, Post building stages - Architectural Reuse, Waste prevention, Construction and Demolition recycling- Conservation of natural and building resources- Energy and material savings – types of wastes - Elimination of waste and minimize pollution- various Decomposing methods – Innovative reuse of various wastes.

References:

1. Bose B.C., *Integrated Approach to Sustainable Development*, Rajat Publications, Delhi, 2001.
2. Laurie Baker, *Chamoli Earthquake Hand Book*, Costford (Centre of Science and Technology for Rural Development), 2000.
3. Moore F., *Environmental Control Systems: Heating, Cooling, Lighting*, McGraw Hill, New York, 1993.

4. Langston C. A. and G. K. C. Ding, *Sustainable Practices in Built Environment*, 2/e, Butterworth-Heinmann, 2001.
5. Trivedi R. N., *Environmental Sciences*, Anmol Publications Pvt. Ltd, New Delhi, 2005..
6. Wright R. T. and B. J. Nebel, *Environmental Science: Towards Sustainable Future*, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.

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:

- *comprehend sustainable development concept in civil engineering practices.*
- *choose materials and evolve construction procedures to suit sustainable development.*
- *choose energy efficient materials and construction techniques.*
- *adopt and suggest waste reduction methods in construction industry.*

13.704.10 COASTAL ENGINEERING (C) (Elective I)

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

Course Objective:

To provide knowledge on the mechanics of ocean waves and its applications in Coastal Engineering.

Module – I

Introduction , Impact on Coastal Environment due to human activities- Integrated Coastal Zone Management (ICZM) and its importance in India, Ocean Waves and their generation-Classification of waves- Wave theories-Linear wave theory- wave length and Celerity-Water particle velocity- Water particle acceleration-Water particle displacement- Pressure with in a Progressive wave-Wave Energy.

Module – II

Group Celerity- Superposition of waves- Wave Transformation in shallow water- Refraction , Shoaling and diffraction- wave breaking – Plunging breaker, spilling breaker-surging breaker-collapsing breaker - wave reflections Clapotis .Brief description on Finite Amplitude Wave theories namely Stokes second order theory, Cnoidal Wave theory, Solitary Wave theory. Wave forecasting- SMB and PNJ methods.

Module – III

Coastal zone process-beach profiles- Near shore and long shore sediment transportation-(descriptions only –no computation) Littoral drift- Wave forces on structures- Wave forces on Vertical walls due to non-breaking waves, breaking waves and broken waves – Problems- Forces on circular cylinders- Morison equation-Froude-Krylov Force.

Module – IV

Harbour Oscillations- Free oscillations in two and three dimensional basins- forced oscillations

Shore protection works-Various types of Break waters, Seawalls, Groynes- Armour units - Hudson's formula- Simple design of Rubble mound breakwater . Beach nourishment and sand bypassing.

References:

1. Mani J. S., *Coastal Hydrodynamics*, PHI Learning Private Ltd. New Delhi.
2. Rober M. Sorensen, *Basic Coastal Engineering*, John Wiley & Sons, New York.
3. *Coastal Engineering Manual* (CEM- US Army Corps of Engineers-)
4. Ippen A. T., *Estuary and Coastline Hydrodynamics*, McGraw Hill, New York.

5. Kamphuis J. W., *Introduction to Coastal Engineering and Management*, Allied Publishers, 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.

Course Outcome:

After successful completion of the course, the students will be able to analyse and design coastal structures like breakwaters, seawalls, harbour etc.

13.704.11 ENVIRONMENTAL SCIENCE AND MANAGEMENT (C) (Elective I)

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

Course Objective:

To give an awareness in the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional endeavour that they participate.

Module – I

Man and environment-Environmental ethics-Interdisciplinary nature of environment-Biosphere-Natural resources of environment- Water, land and energy- Energy resources: growing energy needs- Renewable and nonrenewable energy sources- Use of alternate energy sources. Global environmental issues-Green house effect-Ozone layer depletion-Global warming-Acid rain-Deforestation.

Module – II

Ecology- Ecosystem- Types- functions- Productivity- Energy flow and food chains- Ecological pyramids- material cycling- Hydrologic cycle- Carbon cycle- Nitrogen cycle- Phosphorous cycle- Sulphur cycle.

Environment and Sustainable development- definition- Principles- Objectives- Importance-Sustainable use of natural resources- threats to biodiversity- Habitat loss- Poaching of wildlife, man, wild life conflicts- Endangered and endemic species of India.

Module – III

Waste management hierarchy- Air pollution- sources- types- effects- Air quality standards-Water pollution – characteristics of water pollution- Water quality standards- Solid waste management-Definition-Classification of solid waste-Sources- Benefits of pollution prevention Population explosion and its impact on environment-Consumerism and waste products-Climate change-Environment and human health.

Module – IV

Resource conservation- Water conservation- Needs of water conservation- Rain water harvesting-Conservation of soil.

Applications of modern technologies-Remote sensing and GIS in environment management.

References:

1. Gilbert M. Masters, *Introduction to Environmental Engineering and Science,* 2nd edition, Pearson Education, 2004.
2. Bharucha Erach, *Biodiversity of India,* Mapin Publishing, Ahmedabad, India.

3. Dhameja S. K., *Environmental Engineering and Management, S*. K. Kataria & Sons, 2009.
4. Joseph K. and R. Nagendran, *Essentials of Environmental Studies,* Pearson Educations, 2004.
5. Anji Reddy M., *Remote Sensing and Geographical Information System,* Book Syndicate, 2000.

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 propose any project, or any development activity only after giving due consideration to conserve our natural resources and minimum environmental degradation.

13.704.12 MODERN CONSTRUCTION MATERIALS (C) (Elective I)

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

Course Objective:

- *To introduce the conventional materials and their modern use*
- *To expose the students to recent developments in construction materials.*

Module – I

Building materials-stones, bricks, concrete masonry blocks, multi cell concrete blocks, aerated concrete blocks. Concrete- special concretes for specific purposes like lightweight concrete, ready mixed concrete, high performance concrete, self compacting concrete, ferrocement and Fibre reinforced concrete.

Module – II

Recent developments in the use of glass, ceramic, plastics, asbestos, wood, adhesives, steel and aluminium products. Polymer composites and composite materials. Decorative finishes..

Module – III

Thermal insulating Materials –Properties, products and applications. Energy Efficiency and U Value. Acoustic insulating Materials –Properties, products and applications Water proofing Materials and products. Bituminous materials.

Module – IV

Innovation in materials technology. Geosynthetics and its applications Sustainable Materials. Smart Materials and composites. Construction materials from industrial waste and recycled materials-areas of applications.

References:

1) Michel S. Mamlouk and John P. Zaniewski, *Materials for Civil and Construction Engineers*, Prentice Hall.
2) L. Reed Brantley and Ruth T Brantley, *Building Materials Technology*, McGraw-Hill Publishers
3) Neil Jackson and Ravindra K. Dhir, *Civil Engineering Materials*, Palgrave Foundations
4) Don A Watson, *Construction Materials and Processes*, Career Education
5) F. Young, S. Mindess, R. J. Gray and A. Bentur, *The Science and Technology of Civil Engineering Materials*, Prentice Hall
6) Gandhi M. V. and B. S. Thompson, *Smart Materials and Structures*, Chapmann & Hall, London

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

1. *Describe the various materials used for construction of structures.*
2. *Decide the material most suited and economical for the construction of a structural element.*
3. *Combine durability and sustainability in material selection.*

13.705.1 PRE-STRESSED CONCRETE (C) (Elective II)

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

Course Objective:

To impart to students the knowledge of methods of prestressing, analysis and design of various prestressed concrete elements under relevant codal provisions.

Module – I

Basic concepts and brief history of prestressing, advantages and limitations of prestressing, types of prestressing, prestressing systems and devices, concrete and steel used in prestressed concrete, losses in prestress.

Module – II

Analysis of members under flexure, shear and torsion. Design of flexural members – Type I and Type II sections, design of end block, design for shear and torsion, detailing of reinforcement.

Module – III

Design of one way and two way slabs, Analysis and design of continuous beams. Partial prestressing (concept only).

Module – IV

Composite construction: Concept, types and analysis only. Circular prestressing: Analysis and design of pipes and water tanks.

References:

1) Krishna Raju N., *Prestressed Concrete*, Tata McGraw Hill Company, New Delhi, 2006.
2) Mallick S. K. and A. P.Gupta, *Prestressed Concrete*, Oxford and IBH Publishing, 1997.
3) Rajagopalan N., *Prestressed Concrete*, Alpha Science, 2002.
4) Ramaswamy G. S., *Modern Prestressed Concrete Design*, Arnold Heinimen, New Delhi, 1990.
5) Lin T. Y., *Design of Prestressed Concrete Structures*, Asia Publishing House, Bombay 1995.
6) IS 1343: 1980, Indian Standard Code of Practice for Prestressed Concrete.
7) IS 456: 2000, Indian Standard Code of Practice for Plain and Reinforced Concrete.
8) IS 3370: Part IV: 2009 Code of practice for concrete structures for the storage of liquids.

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 456: 2000, IS 3370: Part IV: 2009, IS 1343: 1980 and Design Tables are permitted in the examination hall.*

Course Outcome:

After successful completion of the course, the students will be able to understand and use suitably the different concepts of prestressing and the design of various prestressed concrete members used in practice.

13.705.2 MECHANICS OF COMPOSITE MATERIALS (C) (Elective II)

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

Course Objective:

Composite materials are finding immense application in the field of aerospace, automobile and Civil engineering presently due to its outstanding material capability. It is required for the present structural engineers to know the fundamentals of composite material for designing composite structures in various fields.

Module – I

Introduction. Composite Fundamentals: Definition of composites, Objectives, constituents and Classification of composites; structure (multilayered and multiphase); General Characteristics of reinforcement- classification, terminology used in fibre science, Polymer matrix composites- Thermoplastics and thermosetting resins; mechanical properties, glass transition temperature. Structural applications of Composite Materials.

Module – II

Macro mechanical behaviour of composite lamina - Review of Basic Equations of Mechanics and Materials and Linear Elasticity in 3D and 2-D plane stress and plane strain - Number of elastic constants and reduction from 81 to 2 for different materials. Stress-Strain Relations for a unidirectional and orthotropic lamina. Effective Moduli of a continuous fibre - reinforced lamina.

Module – III

Micro Mechanical Behaviour of a Composite Lamina - Introduction, Mechanics of Materials approach to Stiffness, Comparison of approaches to stiffness. Determination of lamina stresses and strains. Micromechanics of Failure of unidirectional Lamina. Failure theories- Maximum stress/strain criteria, Tsai-Hill and Tsai-Wu criterion. Hygrothermal effects on material properties on response of composites.

Module – IV

Macro mechanical behaviour of a laminate- Classical Lamination Theory, stress-strain variation, In-plane forces, bending and twisting moments, Effects of stacking sequence-coupling effects, special cases of laminate stiffness. Laminate strength analysis procedure-Failure envelopes, Progressive failure Analysis. Free-Edge inter-laminar Effects.

References:

1) Jones M. Roberts, *Mechanics of Composite Materials*, Taylor and Francis, 1998.
2) Reddy J. N., *Mechanics of Laminated Composite Plates: Theory and Analysis*, CRC Press, 2006.

3) Calcote L. R., *Analysis of Laminated Composite Structures*, Van Nostrand, 1969.
4) Vinson J. R. and P. C.Chou, *Composite Materials and Their Use in Structures*, Applied Science Publishers, London, 1975.
5) Agarwal, B.D. and L. J. Broutman, *Analysis and performance of Fibre Composites*, 3/e, Wiley, 1990.

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 have:

- *An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.*
- *A basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.*
- *An ability to predict the failure strength of a laminated composite plate.*
- *An ability to use the ideas developed in the analysis of composites*

13.705.3 GROUND IMPROVEMENT (C) (Elective II)

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

Course Objective:

- *To introduce the various types of improvement methods of engineering properties soils.*
- *To introduce the application of engineering methods to ground improvement projects*
- *To demonstrate how theoretical knowledge and observation of engineering performance assist in rational application of ground modification procedure.*

Module – I

Role of ground improvement- Drainage and Ground water lowering- Well point systems- Electro osmotic methods- Thermal and Freezing methods..

Module – II

In situ densification- Deep compaction- Dynamic Compaction- Blasting-Sand piles- Preloading with sand drains-Stone columns- Lime piles.

Module – III

Earth Reinforcement- Rock bolts- Cables and guniting- Geotextiles as reinforcement- Filtration, Drainage and Erosion Control-Soil Nailing-Micropiles.

Module – IV

Grouting- Types- Rheology- Applications- Electrochemical Stabilization- Physical and Chemical aspects of stabilization- Stabilization with cement lime etc.

References:

1. Manfred Hausmann, *Ground Modification*, Mc Graw Hill, New York, 1990.
2. Purushothama Raj, *Ground Improvement Techniques*, Laxmi Publications, New Delhi, India, 1999.
3. Bell F.G., *Foundation Engineering in Difficult Ground*, Butterworth-Heinmann, 1978.
4. Frank Harris, *Ground Engineering Equipments and Methods*, McGraw Hill Book Company Ltd. New York, 1983.

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:

A study of the many different approaches to the ground modification broadens the mind of any Engineer and inspires creativity and innovation in Geotechnical Construction and related fields; Equips to make an informed decision on the tools for the selection and the design of main interventions for the improvement for particular situation.

13.705.4 GEO-ENVIRONMENTAL ENGINEERING (C) (Elective II)

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

Course Objective:

To impart to the students, the impact of pollution on soil properties, need for landfill and design concepts of land fill.

Module – I

Waste Generation – source, type, quantity, characteristics and management of waste; Geotechnical properties of solid waste - density, particle size, temperature, pH, moisture content, compressibility, permeability, shear parameters; geotechnical reuse of waste materials.

Module – II

Waste dump - changes occurring in waste dump, its impact on environment, remedial measures for waste dump, engineered landfill – types, selection and ranking of landfill sites based on sensitivity index – landfill planning-components of landfill –landfill capacity.

Module – III

Liner and cover system - compacted clay liner, geomembrane liners, geosynthetic clay liner, required properties of liners - insitu permeability measurement of clay liners, Leachate quality and quantity collection pipes, materials for drainage layer; leachate recirculation and Treatment; Gas management and collection facilities.

Module – IV

Soil waste interaction; contaminant transport - advective, diffusive, dispersive and combined process - attenuation capacity- change in engineering properties; permeability, shear strength, Atterbergs limit, compressibility and swell. Soil remediation- soil washing, fixation, electrokinetic remediation, biological treatment, thermal treatment and containment.

References:

1. Datta M, *Waste Disposal in Engineered Landfills*, Narosa publication New Delhi, 1997.
1. Ramanatha Ayyar T. S., *Soil in Relation to Environment*, L B S Centre for Science and Technology, Trivandrum, 2000.
2. Gulathi S. and M. Datta, *Geotechnical Engineering*, Tata McGraw Hill, 2005.
3. Sharby R., *Environmental Geotechnology*, Chapman and Hall London, 2000.
4. Daniel D. E, *Geotechnical Practice of Waste Disposal*, Chapman and Hall, London, 1993.

5. Bachi, *Design Construction and Monitoring of Landfills*, John Wiley and Sons, New York, 1993.

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 basic principles of the design of landfill.

13.705.5 GROUND WATER ENGINEERING (C) (Elective II)

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

Course Objective:

- *To provide students a quantitative understanding of the hydraulics of subsurface fluid flow and its engineering applications.*
- *To provide understanding about characteristics of porous media, Darcy's law of fluid flow in porous media, ground water investigation methods etc.*

Module – I

Vertical distribution of ground water. Types of geologic formations - properties of aquifer related to storage and transmissivity of water. Steady unidirectional flow - steady flow in a homogeneous aquifer - aquifer with recharge - Flow into infiltration galleries – problems from steady unidirectional flow. Steady radial flow towards wells – Discharge through confined and unconfined aquifers - Problems from steady radial flow towards wells.

Module – II

Partial differential equations governing unsteady ground water flow - unsteady radial flow towards well. Estimation of aquifer parameters - Theis method - Jacob's method - Chow's method. - Well flow near aquifer boundaries - Image well system- Law of times - Method of images – Practical cases - Problems from estimation of aquifer parameters and well flow near aquifer boundaries.

Module – III

Wells - Types- Design of wells - Methods of construction of tube wells - Yield of an open well – Pumping test and recuperation test - recuperation test. Geophysical physical investigation of ground water – different methods – surface investigation methods – electrical resistivity method - seismic refraction method- problems from recuperation test and electrical resistivity method.

Module – IV

Quality of ground water- Graphical representations of groundwater quality data- Pollution of ground water - sources, distribution and evaluation of ground water pollution (Brief description only). Seawater intrusion - Ghyben- Herzberg equation - seawater fresh water interface – upconing - preventive measures. Radial collector wells - Artificial recharge of groundwater - different methods. Problems from seawater intrusion.

References:

1. Todd D. K., *Ground Water Hydrology*, Wiley International, 1995.

2. Karanth K. R., *Ground Water Assessment, Development and Management*, Tata McGraw Hill, 2001.
3. Garg S. P., *Ground Water and Tube Wells*, Oxford & IBH Publishing Company PVT Ltd., New Delhi, 1993.
4. Herman Bouwer, *Ground Water Hydrology*, McGraw Hill, Tokyo, 1978.
5. Raghunath H. M., *Ground Water Hydrology*, 3/e, New Age International Publishers, New Delhi, 2007.
6. Neven Kresic, *Hydrogeology and Groundwater Modelling*, CRC Press, Taylor & Francis, 2007
7. Freeze R. A. and A. Cherry, *Ground Water*, Prentice Hall, New Jersey, 1979.
8. Rastogi A. K., *Numerical Groundwater Hydrology*, Penram International Publishers, Mumbai, 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:

- *Understand the occurrence and movement of groundwater through porous media.*
- *Apply Darcy's Law to simple groundwater flow problems.*
- *Design and conduct experiments, as well as to analyze and interpret data.*

13.705.6 SOLID WASTE MANAGEMENT (C) (Elective II)

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

Course Objective:

- *To introduce the solid waste engineering principles and management issues.*
- *To understand the legislation of solid waste management, treatment technologies and current issues*.

Module – I

Definition-Sources- Categories of Wastes- Generation rate- Measure of quantities, methods used to generation rate, Physical and chemical composition (simple problems)- Storage of solid waste at source- Container storage location.

Module – II

Collection-collection services-collection systems, collection routes-Need for transfer operation. Processing techniques- Mechanical volume reduction, mechanical size reduction-chemical volume reduction-component separation. Drying and dewatering (simple problems), Importance of waste transformations in solid waste management, Energy production from biological conversion products.

Module – III

Disposal of solid waste; Sanitary landfill-area method, trench method- Landfill classifications, types and methods- Landfill siting considerations- advantages and disadvantages. Incineration-types of incinerators- parts of an incinerator- advantages and disadvantages. Composting-types of composting-Indore process, Bangalore process, advantages and disadvantages.

Module – IV

Types of plastics now recycled- Major legislations- Solid waste disposal Act 1965, National Environmental policy Act 1969, Resource Recovery Act 1970, Resource Conservation and Recovery Act 1976, Public Utility Regulations and Policy Act 1981.

References:

1. George Tchobanoglous, Hilary Theisen, Samuel Vigil *Integrated Solid Waste Management,* McGraw Hill, New York.
2. Aarne Vesilend P., William Worrell, Debra Reinhart, *Solid Waste Engineering,* Cengage Learning India Pvt. Ltd.
3. George Tchobanoglous, Frank Kreith et al, *Handbook of Solid Waste Management,* McGraw Hill, New York.
4. David A. Cornwell and Mackenzie L. Davis, *Introduction to Environmental*

Engineering, McGraw Hill.
5. Robert A. Corbitt, *Handbook of Environmental Engineering,* 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 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 develop appropriate solid waste management strategies to meet local needs.

13.705.7 TRANSPORTATION PLANNING (C) (Elective II)

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

Course Objective:

- *To introduce the role of planning in analysing and modelling travel demand.*
- *To understand the stages involved in the Urban Transportation Planning process.*
- *To study the principle of land use transport interaction models, it's mathematical formulation and solution.*

Module – I

Systems approach to urban transportation planning concepts; flow chart for transportation Travel demand concepts, Data needs for planning process, Use of secondary data. Definition of the study area. Cordon line, screen line, Zoning, sample size determination, Data collection techniques. O-D surveys.

Module – II

Travel demand estimation; Trip generation analysis-Aggregate analysis, dis-aggregate analysis, Regression analysis. Types of regression models-linear, non-linear, multiple regression models. Category analysis. Trip distribution analysis. Growth models- Fratar and Furness models. Various forms of the gravity models. Opportunity models- Intervening opportunity and competing opportunity models.

Module – III

Modal split analysis, Modelling travel behaviour. Aggregate and Dis-aggregate Models, Probabilistic models- probit and logit models. Trip assignment models. Minimum path assignment. All or nothing assignment, Equilibrium assignment, Capacity restrained assignment, Multiple path assignment. Diversion curves.

Module – IV

Landuse-transport models. Lowry model. Lowry Garin model. Iterative solutions. Introduction to some transportation planning softwares.

References:

1) Bruton M. J., *Introduction to Transportation Planning*, Hutchinson, London.
2) Dickey J. W., *Metropolitan Transportation Planning*, McGraw Hill, New York.
3) Hutchinson B. G., *Principles of Urban Transportation Planning*, McGraw Hill, New York.
4) Meyer D. Michael and Miller Eric J,, *Urban Transportation Planning: A Decision-Oriented Approach*, McGraw Hill.
5) Partha Chakroborty, *Principles of Transportation Engineering*, Prentice-Hall.

6) Kadiyali L. R., *Traffic Engineering and Transport Planning*, Khanna Publishers, *New Delhi.*

7) Nicholas J. Garber and Lester A. Hoel*, Principles of Traffic and Highway Engineering*, Cengage Learning Pvt. Ltd, 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.

Course Outcome:

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

- *Understand the various transportation planning concepts*
- *Understand four step modelling concept in Urban Transportation Planning.*
- *Familiarise the mathematical travel demand model development, concepts and its solutions.*

13.705.8 ADVANCED COMPUTATIONAL METHODS (C) (Elective II)

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

Course Objective:

- *To provide an insight to the numerous numerical techniques available for the simulation and solution of many physical problems in the Civil Engineering field.*
- *To give exposure to programming in numerical methods, which may help them during higher studies.*

Module – I

Errors in numerical computation – System of linear algebraic equations –Ill-conditioned systems – Symmetric and Banded systems – Elimination method – Factorization method – Choleski's method. System of non linear equations – Newton-Raphson Method.

Eigen value problems – Power method – Jacobi Method – Practical examples.

Module – II

Data smoothing by least squares criterion – parabolic and non-polynomial models like exponential model and power equation – Multiple linear regression method.

Lagrangean and Hermitian interpolation – Quadratic splines - cubic splines (Examples with equal intervals only).

Module – III

Solution of first-order ordinary differential equations by use of Taylor series – Euler's method and its modifications – Runge-Kutta method – Predictor-corrector methods – Milne's method – Stability of solution.

Higher order equations of initial value type by Runge-Kutta method.

Ordinary differential equations of the boundary value type – Finite difference solution.

Module – IV

Partial differential equations in two-dimension – Parabolic equations – Explicit finite difference method – Crank-Nicholson implicit method.

Elliptic equations – Finite difference method –- Problems with irregular boundaries.

Weighted residual methods for initial value problems and boundary value problems – Collocation method – Subdomain method – Method of least squares – Galerkin's method.

Note: Importance must be given to structural engineering problems wherever possible. Assignments must be computer oriented.

References:

1. Gerald and Wheatly, *Applied Numerical Analysis,* Pearson Education.

2. Chapra S. C. and R. P. Canale, *Numerical Methods for Engineers,* McGraw Hill, 2006.
3. Smith G. D. *Numerical solutions for Differential Equations,* McGraw Hill.
4. Ketter and Prawel*, Modern Methods for Engineering Computations,* McGraw Hill.
5. Rajasekharan S., *Numerical Methods in Science and Engineering,* S Chand & Company, 2003.
6. Rajasekharan S., *Numerical Methods for Initial and Boundary value problems,* Khanna Publishers, 1989.
7. Terrence. J. Akai, *Applied Numerical Methods for Engineers,* Wiley Publishers, 1994.
8. Grewal B. S., *Numerical Methods for Engineers & Scientists, Khanna Publishers*.

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:

The students after undergoing this course will be able to

- *demonstrate various methods available for scientific computations.*
- *obtain numerical solutions of ordinary and partial differential equations.*
- *apply appropriate numerical techniques for the solution of civil engineering problems.*

13.705.9 OPTIMIZATION TECHNIQUES IN ENGINEERING (C) (Elective II)

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

Course Objective:

- *To develop the ability to formulate the real field engineering problems in an optimization framework.*
- *To develop the ability to use optimization techniques for real life applications.*

Module – I

Optimization - steps in optimization problem solving, basic terminologies, concavity and convexity of mathematical functions, types of optimization problems.

Formulation of different types of optimization problems-minimum weight design of beams, columns, trusses and frames, water quality modeling, minimum cost design of irrigation canals.

Module – II

Solution of optimization problems- Single variable unconstrained optimization techniques-one dimensional minimization. Elimination methods-Interval halving, Fibonacci search and Golden section methods.

Solution of multivariable unconstrained problems. Solution of multivariable constrained problems-Lagrange multiplier method. Direct search methods-conceptual ideas of random search method and grid search method. Univariate Method, Pattern search method-Powell's method.

Module – III

Gradient based methods- steepest descent method, Fletcher Reeves method, Newton method, Quasi Newton method- BFGS method.

Conceptual ideas of (No problems) Reliability based optimization, Constraint handling-Penalty function approach, Multi-objective optimization, dynamic programming and Bellman's principle of optimality etc.

Module – IV

Linear programming (LP)-two phase solution of Simplex method, Duality of LP problems, Integer programming- Gomory's cutting plane method. Geometric programming- minimum weight design of trusses.

References:

1. Rao S. S., *Engineering Optimization – Theory and Practice*, New Age International.
2. Deb K., *Optimization for Engineering Design–Algorithms and Examples*, Prentice Hall.

3. Kirsch U., *Optimum Structural Design*, McGraw Hill.
4. Arora J. S., *Introduction to Optimum Design*, McGraw Hill
5. Haftka R. T. and Z. Gurdal, *Elements of structural Optimization*, Springer.
6. Fox R L., *Optimization Methods for Engineering Design*, Wiley Interscience.
7. Belegundu and Chandrapatla, *Optimization Concepts and Applications in Engineering*, Prentice Hall India Ltd.
8. Taha H. A., *Introduction to Operations Research*, Prentice Hall, New Jersey.

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. At least one assignment should be computer oriented. One assignment can be to create general awareness of search based algorithms for engineering problem solving.

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:** Questions with more than two variables should not be asked from Module II and Module III*

Course Outcome:

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

- *Describe the basic concepts of optimization*
- *Formulate the optimization models for real field engineering problems*
- *Select and apply appropriate method for solving real life problems.*

13.705.10 DESIGN OF OFFSHORE STRUCTURES (C) (Elective II)

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

Course Objective:

- *To impart basic knowledge in civil engineering aspects of offshore structures.*
- *To familiarize the students in the areas of design aspects of offshore structures.*

Module – I

Loads on Offshore Structures: Wind Loads; Wave and Current Loads; Calculation based on Maximum base Shear and Overturning Moments; Design Wave heights and Spectral Definition; Hydrodynamic Coefficients and Marine growth; Fatigue Load Definition and Joint Probability distribution; Seismic Loads.

Different types of ocean structures and systems - Gravity, fixed, floating semi submersibles, compliant structure-Tension legged platform and guyed tower.

Module – II

Design of fixed offshore Jacket Platform-Steps in design. Environmental load calculation (wind, wave, current and tidal) and design parameters. Problems on checking the sufficiency of tubular members under different loading conditions in conformity with the API-Code. Tubular Joints-different types. Analysis of Joints, Stress concentration factor, fatigue failure-SN curves.

Module – III

Basic principles of design of concrete offshore platforms - Jack up platforms, Wave forces on large structures-Froude-Krylov Forces-General theory. Design of compliant structures forces & bending moments in floating platforms Design principles of - Tension leg platform Sizing and mechanics –weight estimate of TLP.

Module – IV

Mechanics of mooring lines-steady state forces in mooring line due to current. Equation of static equilibrium. Integration of equilibrium equations –heavy and short cables-neutrally buoyant cables, Profile of cable line under all forces considered- Critical angle. Sub sea pipeline-pipeline safety .Design Process –internal pressure-external pressure. On bottom stability-objective- static analysis. Laying Pipe line - different methods.

References:

1. Thomas H. Dawson, *Offshore structural Engineering.*
2. Subrata K. *Chakrabarti*, *Wave Hydrodynamics*, Prentice Hall Inc. Englewood Cliffs, N.J. 1983.

3. Subrata K. *Chakrabarti*, *Hand book of Offshore Engineering* (Vol. I & II). Elsevier Science, 2005.
4. Hsu Teng H., *Applied Ofshore Structural Engineering*, Gulf Publishing Company Book Division, Houston, Texas, 1984.
5. Henri O. Berteaux, *Buoy Engineering*, Umi Research Pr., 1976.
6. George A. Antaki, *Piping and Pipeline Engineering*, CRC Press, 2003.

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 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 the effects of various forces acting on offshore structures.*
- *Plan and design offshore structures.*

13.705.11 TRANSPORTATION SYSTEM MANAGEMENT (C) (Elective II)

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

Course Objective:

- *To gain an understanding of the basic principles of planning transport systems.*
- *To provide an understanding of the principles of urban transport and the requirements of an efficient transport system.*

Module – I

Transportation System Management-objectives and scope-Need for TSM, TSM Process outline, TSM Strategies –Performance Measures.

Traffic Operations Improvement: On-street parking ban, one-way streets, reversible lanes, traffic calming, Right turn phase, right turn lanes, reroute turning traffic, Auto Restricted Zones-Traffic Diverters.

Module – II

Study of TSM actions with respect to problems addressed, conditions for applications, potential implementation problems, evaluation & impact analysis- park and ride, Ridesharing, exclusive lanes, priority at ramp terminals, bus transfer stations, limited and skip-stop bus services, Public transportation & HOV treatment.

Module – III

Demand Management: Staggered work hours, flexible work hours, high peak period tolls, shuttle services, circulation services, extended routes.

Local Area Traffic Management-Data Requirements-pedestrian Facilities-Planning for pedestrians, Bicycle Facilities-Design .Non Motorized Transport: pedestrian only streets, Dial a ride for elderly & handicapped.

Module – IV

Parking Management: Benefits of good parking management, curb parking, off street parking, Parking supply and demand, Parking and Terminal Facilities.

References:

1 Arlington D., *Transportation System Management in 1980: State of the Art and Future Directions*, Transportation Research Board, 1980.

2 Institute of Transportation Engineers, *Transportation and Traffic Engineering Hand Book*, Prentice Hall, 1982.

3 Garber N. J. and L. A. Hoel, *Traffic and Highway Engineering*, Cengage Learning, 2014.

4 Khisty C. J. and B. K. Lall, *Transportation Engineering - An Introduction*, Prentice Hall, 2003.

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 this course, the students will be able to apply an array of planning management techniques for improving transport efficiency in a city and solving problems such as congestionto demonstrate various methods available for scientific computations.

13.706 ENVIRONMENTAL ENGINEERING LAB (C)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

- *To get an idea of sampling and preservation of water samples.*
- *To make an awareness on the importance of drinking water standards and its specified limits.*
- *To get the practical experience in analysis of water samples.*

***Pre requisites**: 13.502 Environmental Engineering I (C)*

List of Experiments:

Analysis of water for any eight of the following:

1. pH, Turbidity
2. Hardness
3. Acidity
4. Alkalinity
5. Residual Chlorine
6. Chlorides
7. Dissolved Oxygen
8. Total Solids
9. a) Sulphates
   b) Sulphides
10. Iron
11. Jar Test

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

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

Questions based on the list of experiments prescribed.

80% - Theory, Procedure and tabular column (30%);

Conducting experiment, Observation, Tabulation with Sample calculation (30%)

Graphs, Results and inference (20%)

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

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

- *Characterize the water sample*
- *Identify the importance of drinking water standards and their permissible limits.*

13.707 GEOTECHNICAL ENGINEERING LAB (C)

Teaching Scheme: 0(L) - 0(T) - 2(P) **Credits**: 2

Course Objective :

- *To achieve practical experience in testing of soils.*
- *To get familiar with standard quality laboratory testing procedures for determining the basic properties and engineering behavior of soil.*

***Pre requisites**: 13.504 Geotechnical Engineering I (C)*

List of Experiments:

1. Determination of Specific Gravity
    - Pycnometer Method
2. Determination of Field Density and Void Ratio
    - Sand Replacement Method
    - Core Cutter Method
3. Particle Size Determination
    - Sieve Analysis
    - Hydrometer Analysis
4. Consistency(Atterberg) Limits Determination
    - Liquid Limit Test
    - Plastic Limit Test
    - Shrinkage Limit Test
5. Permeability Determination
    - Constant Head Permeameter Test
    - Variable Head Permeameter Test
6. Shear Strength Determination
    - Unconfined Compression Test
    - Direct Shear Test
    - Triaxial Compression (UU) Test (Demonstration only)
7. Consolidation Test
8. Compaction Test
    - Standard Proctor Compaction Test

***Note**: The relevant IS Codes on methods of testing should be adopted for the above tests.*

Reference:

1. Ranjan G. and A. S. R. Rao, *Basic and Applied Soil Mechanics*, New Age International.
2. Arora K. R., *Geotechnical Engineering*, Standard Publishers

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test

40% - Class work and Record

20% - Regularity in the class

University Examination Pattern:

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

Questions based on the list of experiments prescribed.

80% - Theory, Procedure and tabular column (30%);

Conducting experiment, Observation, Tabulation with Sample calculation (30%)

Graphs, Results and inference (20%)

20% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

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

- *Determine the basic and engineering properties of soils relevant to field application*
- *Analyse and document the results.*

13. 708 SEMINAR, SURVEY CAMP & INDUSTRIAL VISITS (C)

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

Course Objective :

- *The seminar provides students adequate exposure to public presentations to improve their communication skills.*
- *Industrial visits expose the students to real-life industrial situations and research activities.*
- *Survey camp helps the students to improve their ability to perform as an individual as well as a team member in completing a project work.*

(a) SEMINAR

Each student is required to present a seminar on a topic of current relevance in Civil Engineering and other related areas of current importance. They are expected to refer research and review papers from standard journals like ASCE, IEI, ELSEVIER, etc. Each student shall give a power point presentation of 15 minutes duration on his/her seminar topic in an audience of students and staff members from the department.

Students from lower semesters may also attend the seminar presentation. The seminar presentation shall be assessed by a panel consisting of the Head of the Department, seminar coordinator, and 2/3 faculty members. The Head of the Department shall be the chairman of the panel.

Each student should also prepare a well-documented report on the seminar topic as per the format and submit to the department at the time of his/her seminar presentation. While preparing the report, at least three cross references must be used. The seminar report must not be the reproduction of the original report.

(b) (i) SURVEY CAMP &

Survey Camp should be completed before the commencement of 7^{th} semester. The minimum duration of the survey camp should be one week. The use of total station and GPS is compulsory for survey work.

(ii) INDUSTRIAL VISITS

Students have to visit at least three industries/ research institutes relevant to civil engineering as part of industrial training to understand the processes/activities.

A report of the same should be submitted at the end of 7^{th} semester and evaluation should be based on this report. A certified report on industrial visits should be available with the student for Project and Viva voce at the end of Eighth semester.

Internal Continuous Assessment *(Maximum Marks-150)*

40% - Seminar

30% - Survey Camp and report

30% - Industrial Visits and report

Course Outcome:

This course shall provide students better communication skills, exposure to working of industries and improve their leadership quality as well as the ability to work in groups, and thus aid them in building a successful career as a civil engineer