5CE4-01: Structural Analysis - I

5CE4-01: Structural Analysis - I

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To obtain fundamental understanding of different types of structures and their characteristics based on which their analysis procedures are determined.
2. To understand different analysis procedures of plane determinate truss.
3. To obtain an understanding on shear force, bending moment, and displacement of structure using various methods.
4. To obtain an understanding on rolling load and influence line diagram for determinate and indeterminate structures.
5. To understand different methods for analysis of indeterminate structure.

Course Outcomes: Upon completion of this course the students will be able to:

1. Classify different type of structures
2. Determine the stress resultants, degrees of freedom, static and kinematic indeterminacy of a structure.
3. Analyze a plane determinate truss.
4. Derive the expression of strain energy of a structural component due to different stress resultants and also the deflection of beams from the strain energy function.
5. Draw the influence line diagrams for determinate and indeterminate structures.
6. Analyze indeterminate beams and simple plane frames by applying different methods of analysis.

S.N.	Contents	Hours
1	**Basic concepts** Structural Systems - Degrees of Freedoms, Static indeterminacy, Kinematic indeterminacy. Determinate and indeterminate structures. Stability- Unsymmetrical bending, Shear centers.	06
2	**Analysis of plane trusses** Basic Principles, Types of supports, Analysis by Method of joints and by Method of sections	04
3	**Analysis of plane beam and displacement of statically determine structures** Support reactions, Shear force and bending moment in statically determinate beams; Determination of slope and deflections of beams using successive integration method – Macaulay's Method, 'Moment of the Area' Method, Conjugate beam method	06
4	**Strain energy and its usage for determination of displacement of statically determine structures** Strain energy due to axial load, bending, and shear; theorem of minimum potential energy, principle of virtual work, law of conservation of energy; Deflection of Beams using Strain Energy Method. Castigliano's 1st and 2nd Theorems, Deflection of Beams using Virtual work method, Castigliano's theorem and the Unit load method.	10
5	**Rolling loads & influence lines** Rolling loads and Concept of Influence lines – Influence lines for reactions, shear force and bending moment in beams – load position for maximum shear force and bending moment at a section in beam – Absolute maximum bending moment in beams- Influence lines for member forces in Trusses –Muller Breslau's Principle.	8

6	**Analysis of indeterminate structures** Indeterminate Structures: Analysis of Fixed beam, Continuous beam and simple frames with and without translation of joints by method of Consistent Deformation. Three moments Theorem for continuous beams, Analysis of Propped Cantilever.	8
	Total	**42**

SUGGESTED READINGS

1. Hibbler, R. C. (2006). Structural Analysis, 6th edition, Pearson Prentice Hall, New Delhi.
2. Wang, C.K. (2017). Intermediate Structural Analysis, McGraw Hill Education, ISBN-13: 978-0070702493
3. Reddy, C. S. (2017). Basic Structural Analysis, TATA McGraw Hill Publishers.
4. Gali, A., Newville, A. M., Brown, T. G. (2009). Structural Analysis – A Unified Classical and Matrix Approach, Sixth Edition, Spon Press, UK.
5. Patil, H. S., Patil, Y. D., Patel, J B. (2016). Structural Analysis-I, Synergy Knowledge ware Publisher, Mumbai.
6. Gahlot, P. S., Gehlot, D. (2012). Fundamentals of Structural Mechanics, CBS Publisher, New Delhi.
7. Thandavamoorthy, T. S. (2011). Structural Analysis, Oxford University Press, New Delhi.

5CE4-02: Concrete Structures -I

5CE4-02: Concrete Structures -I

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To impart knowledge on basic of concepts of design of reinforced concrete structures and
2. Make the students able to design and detail the basic elements like beam, slab, column, and footing using reinforced concrete.

Course Outcomes: Upon completion of this course the students will be able to:

1. Understand various design philosophies.
2. Analyze and design of beams for flexure, shear, torsion and bond stress using limit state design method.
3. Analyze and design structural members for serviceability condition.
4. Analyze and design of beam, slab, column, and footing using reinforced concrete.

S.N.	Contents	Hours
1	**Introduction** Introduction to RC Elements, Loads on Structures, Design Philosophies - Working stress and limit state methods, Codes of Practice, Materials for reinforced cement concrete (RCC) – Design loads – Concrete structural systems – Basis of structural design – Principles of limit state design – Characteristics strength and design strength, idealized stress-Strain curve for materials – Design codes (IS 456:2000, IS:875, IS:13920 (2016), IS:1893(2016))	07
2	**Limit state design of beams under flexure and shear** Limit state of Collapse in Flexure – Design parameters of stress block – Analysis of singly reinforced rectangular sections – Moment of resistance – Design of singly and doubly reinforced rectangular section – Analysis and design of flanged beam sections. Behavior of RC Beams under shear –Design for torsion and shear	11
3	**Limit state design of slabs** Types of slabs – Behavior of one way and two-way slabs – Design of one way simply supported and continuous slabs – Design of two-way slabs.	08
4	**Limit state design of columns** Types of columns – Behavior of axially loaded RC Columns-Uniaxial and Biaxial loaded column – Practical provision on Reinforcement Detailing.	08
5	**Limit state design of footing** Types of footings – General design consideration for RC Footings – Structural design of axially loaded isolated rectangular and circular footings – Analysis of footing subjected to vertical load and moments.	08
	Total	**42**

SUGGESTED READINGS

1. Pillai, S. U. and Menon, D. (2009). Reinforced Concrete Design, 3rd edition, Tata Mc Graw Hill Publication Ltd, New Delhi.
2. Subramanian, N. (2013). Design of Reinforced Concrete Structures, Oxford University Press, New Delhi.
3. Sinha, S. N. (2006). Reinforced Concrete Design, 2nd edition, Tata Mc Graw Hill Publishing Co., Ltd, New Delhi.
4. Gambhir, M. L. (2006). Fundamentals of Reinforced Concrete Design, Prentice Hall of India, New Delhi.

5CE4-03: Steel Structures-I

5CE4-03: Steel Structures-I

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To analyze behavior of simple steel members in tension, compression, and flexure
2. To design steel tension members, columns, beams, beam-columns and column bases
3. To analyze and design connections in steel construction.
4. To design slightly complex members such as built-up columns and plate girders

Course Outcomes: Upon completion of this course the students will be able to:

1. Understanding the general practice in steel construction based on Limit State Design
2. Design simple components in structural steel construction.
3. Design moderately complex components in steel construction.

S.N.	Contents	Hours
1	**Introduction to Steel Structures:** Types of Steel Structures, Rolled Steel Sections, Built-up Steel Sections, Characteristics of Steel, Stress-Strain Curve, Types of Loads on Structures, Codes of Practice, Steel-Section Tables, Uniaxial Stress-Strain Behavior of Steel Design Philosophies: Working Stress Method, Factor of Safety, Allowable Stresses. Limit State Method, Partial Safety Factors, Design Loads, Design Strengths. Tension Members: Gross-Area, Net Area, Service Loads, Design of Flats, L-section, I-section and Channel-section as tension members	2+ 2+ 4= 8
2	**Compression Members:** Slenderness Ratios, Global and Local Buckling, Design Stresses; Design using Rolled Steel (I and L) Sections - Design of short column (Struts) and Long Columns; Design of Compound Columns; Introduction to Steel Columns of Built-up Sections with Lateral Connection Systems, Design of built-up Columns and their Lateral Connections	8
3	**Beams:** Plastic analysis of bending of beam, Plastic behavior and development of Elastic and Plastic Moments in beams, Classification of beam sections as per bending behavior – Plastic, Compact, Semi-compact, Slender; Rolled Steel Sections used for beams, Beams with single span, multiple spans, cantilever support; Built-up Beams, Support conditions of ends and top flange, Lateral torsional buckling, Design of above beams without and with lateral torsional buckling for Flexure and Shear.	8
4	**Riveted and Bolted Connections:** Types of Joints, Failure Mechanisms, Strength of Rivets and Bolts, Pitch, Gauge, Edge Distance, Design of bolted connections – Lap joints, Double cover butt joints (with and without filler plate), single cover. **Welded Connections:** Types of Joints, Failure Mechanisms, Strength of Weld, Minimum and Maximum Size, Minimum Length, Design of welded joints (both eccentric and centric) Eccentric Connections: Design of Beam-Column Joints and Column Base.	10
5	Introduction to Plate Girders, Steel Bridges, Steel Towers **Plate Girder:** Shear in Plate Girder, High Shear Condition, Analysis and Design of Plate Girder	2+6

	Total	**42**

SUGGESTED READINGS

1. Subramanian, N (2016). "Design of Steel Structures – LIMIT STATE METHOD", Oxford Higher Education. ISBN10 – 9780199460915
2. IS 800: 2007 "General Construction in Steel – Code of Practice", Bureau of Indian Standards
3. Duggal, S. K. (2014). "Limit State Design of Steel Structures", McGraw Hill Education.

5CE4-04: Geotechnical Engineering -II

5CE4-04: Geotechnical Engineering -II

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To learn how three phase system is used in soil and how are soil properties estimated using three phase system.
2. The course will explain the role of water in soil behavior and how soil stresses, permeability and quantity of seepage including flow net are estimated.
3. The course will impart the knowledge of compaction, estimating the magnitude and time-rate of settlement due to consolidation.
4. Impart knowledge of determining shear parameters and stress changes in soil due to foundation loads, earth pressure theory and slope stability.

Course Outcomes: Upon completion of this course the students will be able to:

1. Calculate stresses in soil under various types of loading.
2. Find compressibility & consolidation characteristics.
3. Check slope stability of embankment & calculate amount of Earth pressure.
4. Calculate safe bearing capacity.
5. Calculate the earth pressure and use it for stability analysis.
6. Carry out Soil investigation, geophysical investigation for foundation.

S.N.	Contents	Hours
1	Stress in Soil under Surface Loading: Bossinesq's and Westergaard's analysis of vertical pressure and its distribution in a soil mass. Vertical stresses, horizontal and shear stresses (due to concentrated loads). Isobar diagram, Vertical stress distribution on a horizontal plane. Influence diagram. Vertical stresses at point under line load and strip load. Vertical stresses at a point under circular and rectangular loaded area, New Marks' chart. Pressure bulb and its significance in Foundation exploration. Stresses in soil below foundations.	9
2	Compressibility and Consolidation: One-dimensional consolidation of soil, Degree of consolidation, consolidation test. Terzaghi's one-dimensional consolidation theory, Compressibility parameters, co-efficient of consolidation. Preconsolidation pressure and its determination. Normally, over and under consolidated soils. Methods of predicting settlement & its rate. Total and differential Settlement. Stability of Slopes: Classification of slopes, Stability analysis of infinite slopes. Stability of finite slopes by Swedish and Friction circle method. Taylor's stability number curves.	8
3	Earth Pressure: Active, passive and earth pressure at rest Rankine's and Coulomb's theories Rebhann's and Culman's graphical method for active earth pressure (vertical and inclined back retaining walls), horizontal and inclined cohesionless back fill. Stability analysis of retaining walls.	8
4	Bearing Capacity of Soils: Terminology related to bearing capacity. Common types of foundations. Terzaghi and Meyehoff's theory for bearing capacity. Rankine's method for minimum depth to foundation Skempton's method. Effect of water table on bearing capacity. IS code method to determine bearing capacity. Plate load and penetration tests.	9

5	Site Investigations: Planning of Investigations. Methods of explorations, depth of exploration. Undisturbed and disturbed samples. Types of Samples. Brief description of procedures of sampling, Transportation and storage of samples, Depth, number & extent of boreholes Geophysical methods of investigations. Foundations: Introduction to pile, well and machine foundations.	8
	Total	**42**

SUGGESTED READINGS

1. Budhu, M. (2011). Soil Mechanics and Foundation, John Wiley & Sons, Inc.
2. Braja M. Das. (2014). Principles of Geotechnical Engineering. Cengage learning Pvt. Ltd, 8th Edition.
3. Ranjan G. & Rao, A.S.R. (2016). Basic and Applied Soil Mechanics. New Age International, New Delhi.
4. Holtz R and Kovacs, WD, Thomas C. Sheahan (2010): Introduction to geotechnical engineering, Pearson.
5. Arora, K.R. (2020). Soil Mechanics & Foundation Engineering, Standard Publisher Dist. ISBN-13:978-8180141126.
6. Gulhati, Shashi K & Datta Manoj (2017). Geotechnical Engineering Principles and Practices, McGraw Hill Education.
7. Coduto, Donald P., Yeung, Man-chu R., Kitch, William A. (2017). Geotechnical Engineering Principles and Practices, Pearson Education Ltd.
8. Punmia, B. C., Jain, A. K. and Jain, A. K. (2017). Soil Mechanics and Foundations, Laxmi Publication, New Delhi, (2017).
9. Lambe. T. William and Whitman, Robert V. (2012). Soil Mechanics: Wiley India Pvt Ltd, ISBN-13: 978-8126539918.

5CE4-05: Transportation Engineering-I

5CE4-05: Transportation Engineering-I

Credit: 3Max **Marks: 100 (IA=30, ETE=70)**

3L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To introduce the fundamentals of highway engineering, including development plans, geometric design, and construction processes.
2. To provide the students with in-depth knowledge and understanding of the principles governing the geometric design of highways.
3. To understand the construction procedure and material specifications of rigid and flexible pavements.
4. To apply the design procedures to a "real life" highway design & maintenance project.

Course Outcomes: Upon completion of this course the students will be able to:

1. Diverse knowledge of highway engineering practices applied to real-life problems.
2. Design highway geometrics, the vertical profile of the road, factors controlling the alignment, and explain sight distances and horizontal and vertical curves.
3. Describe the properties of highway materials, design flexible and rigid pavements and explain factors to consider for various types of pavements.
4. Understand the principles of the construction and maintenance of highways.

S.N.	Contents	Hours
1	Highway Development Plans: Historical Development; Functional classification of rural and urban roads; Planning Visions – 2021 (Rural Highways), 2025 (Rural roads), National Urban Transport Policy (NUTP), PMGSY; Components of Detailed Project Report (DPR) of roads; Public Private Partnership Models.	6
2	Highway alignment: basic requirements for an ideal alignment, factors governing highway alignment, highway location surveys and studies, highway alignment in hilly areas, drawings and reports, highway project preparation. Geometric Design: Design factors; Cross-section elements, Sight distances; Road Alignment - Horizontal and Vertical profiles; Combination of profiles; Placement of utilities and services; Design considerations in hill areas; Design software. Elementary Traffic Engineering: Significance of different Traffic Engineering Studies viz. Speed, Volume, O & D, Parking and Accident's Study. Importance and types of Traffic Signs, Signals, road markings, and Road Intersections.	8
3	Highway Materials and Mix Design: Soil – Desirable properties, Tests – Atterburg limits, Proctor values, CBR, Modulus (k); Stone Aggregates – Desired properties, Tests; Asphalt – Classification, properties, routine tests, and modifiers; Cement and Cement Concrete – Desirable properties for pavements; Bituminous Mix design and Concrete Mix design.	7
4	Pavement Design: Factors affecting design; Traffic volume and Axle load survey; Flexible pavements – Layers, design requirements and IRC-37 based design; Rigid pavements: Layers, design requirements, stresses in layers, Design based on IRC-58.	7
5	Highway Construction: Design specification and construction steps of subgrade, embankments, granular layers (GSB, WBM, WMM), bituminous sub-bases, bases, binder and surface courses, concrete pavement (DLC and PQC), Joints in bituminous and rigid pavements; Guidelines for Externally funded Road Projects.	8

6	Highway Maintenance: Types of surface and sub-surface failures, Evaluation and remedial measures; Drainage – surface and sub-surface, Filter design criteria: Design of overlays based on Benkelman Beam and Falling Weight Deflectometer (FWD)	6
	Total	**42**

SUGGESTED READINGS

1. Kadiyali, L. R. (2019). Transportation Engineering Khanna Publishing.
2. Khanna, S.K. and Justo, C.E.G., (2000). Highway Engineering, Nem Chand & Bros.
3. Wright, Paul H. and Dixon, Karen K., (2004). Highway Engineering, John Wiley & Sons Inc.
4. Papacostas, C.S. and Prevedouros, P.D., Transportation Engineering and Planning, Prentice Hall.
5. Jotin Khisty, C. and Kent Lall, B. (2016). Transportation Engineering – An Introduction, Third edition, Pearson India.
6. Chakroborty, P. and A. Das (2005). Principles of Transportation Engineering, Prentice Hall of India Pvt. Ltd, New Delhi, India.
7. Ministry of Road Transport and Highways. (2013). Specifications for Road and Bridge Works, Fifth Edition, Indian Roads Congress, New Delhi, India.
8. Relevant Indian Roads Congress Codes – Geometric Aspects: IRC:38, 69, 73, 86, SP-23.

   Pavements: IRC:37, 58, 15, 44

   Others: IRC: SP-42, SP-88, MORT&H Specifications and latest publication as available.

5CE4-20: Geotechnical Engineering Lab -II

5CE4-20: Geotechnical Engineering Lab -II

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. To provide students with firsthand experience of performing various geotechnical tests to determine fundamental properties of soils.
2. Through practical exercises, students will learn the procedures for conducting tests related to soil consolidation, shear strength, hydraulic conductivity, mineralogical analysis, and microstructural examination.

Course Outcomes: Upon completion of this course the students will be able to:

1. Solid understanding of geotechnical testing methods and their applications in characterizing soil behavior.
2. Imparting knowledge of and ability to perform laboratory tests needed to determine foundation design parameters

S.N.	Contents
1	Oedometer test for consolidation of soils.
2	Determination of swelling index by swelling pressure test
3	Determination of shear strength parameters of soil by Unconfined Compressive strength Test
4	Determination of shear strength of cohesive soils by Vane Shear Test
5	Determination of shear strength parameters of cohesionless soils by Direct Shear Test
6	Determination of shear strength parameters by Triaxial Test
7	Determination of in–situ shear strength by Standard Penetration test
8	To determine of hydraulic conductivity of soil theoretically and verify by experimental method.
9	To perform XRD and SEM test on the soil

5CE4-21: Transportation Engineering Lab

5CE4-21: Transportation Engineering Lab

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. To provide a platform to undergraduate students for practical implementation of highway materials
2. To study the physical consensus and source properties of aggregate materials.
3. To measure and study the physical properties of bitumen.

Course Outcomes: Upon completion of this course the students will be able to:

1. The principles and procedures of testing Aggregates used in highways
2. The principles and procedures of testing bitumen used in highways
3. The techniques to characterize various pavement materials through relevant tests

S.N.	Contents
1	California Bearing Ratio test
2	Aggregate Los Angeles Abrasion value test
3	Aggregate Impact value test
4	Aggregate crushing value test
5	Aggregate Flakiness and Elongation Index test
6	Aggregate water absorption and specific density test
7	Aggregate Soundness test
8	Bitumen Penetration Test
9	Bitumen Softening Point test
10	Bitumen ductility test
11	Bitumen Flash and Fire Point test
12	Bitumen Viscosity test
13	Bitumen specific gravity test
14	Bituminous Mix design
15	Concrete Mix design

SUGGESTED READINGS

1. Khanna, S.K. and Justo, C.E.G., "Highway Material Testing Manual", Nem Chand & Bros. 2004
2. Relevant Indian Roads Congress Codes – Geometric Aspects: IRC:38, 69, 73, 86, SP-23. Pavements: IRC:37, 58, 15, 44
3. Others: IRC: SP-42, SP-88, MORT&H Specifications and latest publication as available.

5CE4-22: Estimation and Valuation

5CE4-22: Estimation and Valuation

Credit: 1Max **Marks: 100(IA: 60, ETE: 40)**

0L+0T+2P

Course Objectives

1. Understand terminology related to estimates.
2. Acquire knowledge of the methodology of estimating & costing.
3. Calculate the quantity of material used in building construction, road, and canal.
4. Detail estimate of small buildings
5. Calculate the valuation of the building and rent fixation.

Course Outcomes: Upon completion of this course the students will be able to:

1. Know the essential components related to estimation practice.
2. Understand the methods of estimate and costing.
3. Analyze the materials consumption in buildings, rods, canals, etc.
4. Prepare detailed estimates of buildings, roads, and canals.
5. Prepare valuation and rent fixation of building.

S.N.	Contents
1	**Rules and Methods** Rules & methods of measurement/specifications. Long-wall & Short-wall methods Centre line method. Types of estimates. Use of Basic Scheduled Rate Books (BSR) of PWD/CPWD.
2	**Exercises/Problems on Estimation of Quantities** Earthwork in excavation & masonry work in foundation & up-to plinth. Detailed estimates for superstructure items, woodwork, plasters, etc. Estimate of R.C.C and steel work for - Slab - beam – column & trusses. Detailed estimate of small residential building (two-roomed) . Earthwork for Roadwork – earthwork in cutting/filling. . Estimate of Slab Culvert- including all the components. . Earthwork Calculation for canal works in embankment & cutting.
3	**Exercises/Problems in Analysis of Rates** . Rate analysis & preparation of bills – Data analysis of rates for various items of work – abstract estimates. . Building rent calculations

SUGGESTED READINGS

1. B. N., Datta (2020). Estimating and Costing in Civil Engineering Theory and Practice, CBS Publishers & Distributors Private Limited, New Delhi.
2. Birdi, G.S. (2014). "Estimating and costing in Civil Engineering", Dhanpat Rai & Sons, New Delhi.
3. Bellis, H.F. & Schmidt, W.A. Architectural Drafting, McGraw-Hill Book Co. Inc., London, ISBN-13 : 978-0070044180
4. Chakraborty, M. (2006). Estimating, Costing Specifications & Valuation in Civil Engineering, Chakraborty Publisher, New Delhi.

5CE5-11: Air and Noise Pollution

5CE5-11: Air and Noise Pollution

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. Introduction to Air Pollution and its effects, sampling, and measurement.
2. Study the property of atmosphere, meteorological variables, and plume behavior.
3. To develop an understanding of the pollution control methods of particulate matter.
4. Gaseous pollution control methods and Automobile pollutions.
5. To give the concept Air population legislation in India and current topics.

Course Outcomes: Upon completion of this course the students will be able to:

1. Learn about Air Pollution, its effects and measurement with understanding of the Metrological concept and Plume behavior.
2. Understanding of control of particulate Matter by Different Methods and control of Gaseous Pollutants and automobile Pollution.
3. Awareness of Air Pollution Legislation in India and current topic.
4. Understanding the basics about sound and noise including worldwide scenario of noise pollution and different monitoring techniques.
5. They will be able to suggest the control measures to different noise generated from different sources.

S.N.	Contents	Hours
1	Sources and classification of Air Pollution Effects of Air Pollution onHuman health, plants, Animals and Property. Meteorology- Concept of Atmosphere, wind movements. Atmospheric lapse rates, Adiabatic lapse rate and their consequences, Plume behavior. Plume rise-equation, estimation of stack height.	6
2	Pollution control Method of a Particulate matter: Types of Particulate control methods- Settling chambers, cyclone separators, scrubbers, filters and Electrostatic precipitators- Mechanism, Their design and application.	5
3	Gaseous Pollution control method and Automobile Pollution: Types of gaseous Pollution Control method- absorption, adsorption, and combustion process. Automobile pollution- Sources of pollution, composition of auto exhaust & control method	5
4	Air Pollution Legislation and Global Problem: Air Quality Standard, Ambient Air Quality Standard and Emission standard. Air Pollution, legislation and regulation in India.Air Pollution Indices. Global problem of air pollution and its remedial measure. Air Pollution from major Industrial Operations- Case study	6
5	Basics of Sound, Sound propagation in air, Fundamentals of Noise, Difference between sound and noise. Measurement of noise,Sources of noise, Outdoor and Indoor Noise pollution in India, Factors Affecting Noise Pollution, Road Traffic Noise Monitoring, Ambient Noise Monitoring, health effects of noise. Noise Control Measures, Industrial noise control, Principles of Noise Pollution Control, Sound Absorption, Basics about Noise Barrier.	6

	Total	**28**

SUGGESTED READINGS

1. Rao, M.N. and Rao, H.V. N. (2017). Air pollution, M C Graw Hill Education, ISBN-13: 978-0074518717.
2. Agarwal, S.K. (2005). Noise Pollution. APH Publishing Corporation, ISBN-13: 978-8176488334.

5CE5-12: Field Exploration and Geotechnical Processes

5CE5-12: Field Exploration and Geotechnical Processes

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To learn about objectives and stages of site investigation: types of samples and samplers.
2. To know about the different Geotechnical investigation methods.
3. To assess the location of the ground water table.
4. To assess the general suitability of the site.
5. To learn preparation of soil investigation report.

Course Outcomes: Upon completion of this course the students will be able to:

1. The site-specific field investigations methods.
2. The different methods of boring, types of samples and sampling
3. Detailed methods of in-situ soil testing.
4. Detailed methods of soil testing in the laboratory.
5. Prepare the Geotechnical investigation report.

S.N.	Contents	Hours
1	Purpose; Overview of method of soil exploration- Boring, sampling, Standard penetration test, Static and dynamic cone tests, Plate load test; Correlation between penetration resistance and strength parameters.	5
2	Planning of Sub-soil Investigation; Number of bore holes and depth of exploration; Types of tests to suit soil conditions; In-situ method of determination of different soil properties like shear strength, permeability etc.; Determination of water table, underwater subsoil exploration.	7
3	Methods of Geophysical Exploration- Seismic reflection, refraction, and electrical resistivity methods.	6
4	Exploration methods in Rocks-investigation, sequence, drilling, sampling and bore hole inspection; Laboratory method of determining the various properties and behavior of soils.	5
5	Dynamic testing of soils; Method of Geotechnical study for various Civil engineering design and construction; Preparation of necessary report; Instrumentation.	5
	Total	**28**

SUGGESTED READINGS

1. Clayton, C.R.I., Matthews, M.C. and Simons, N.E. (1995) Site investigation: A handbook for engineers, Oxford, GB. Blackwell Science.
2. Richard L. Handy Merlin G. (2007). Geotechnical Engineering Soil & Foundation Principles & Practice, Spangler Publ.
3. Simons, N. E., Menzie, B. K., Matthews, M.C. (2002). A Short course in Geotechnical, Thomas Telford.

5CE5-13: Advanced Concrete Technology

5CE5-13: Advanced Concrete Technology

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. Understand cement hydration and microstructure.
2. Comprehend advanced mixture design principles and particle packing theories.
3. Learn durability aspects, corrosion, and advanced concrete characterization techniques.

Course Outcomes: Upon completion of this course the students will be able to:

1. Identify and explain the phases involved in cement hydration and their role in concrete properties.
2. Utilize particle packing theories to design concrete mixtures for optimal performance.
3. Identify various durability mechanisms and their effects on concrete performance.
4. Consider rheological properties and their influence on concrete behavior during different stages.
5. Interpret data obtained from advanced characterization techniques to understand concrete properties.

S.N.	Contents	Hours
1	**Hydration and micro-structure of cement** Hydration of Cements and Micro-structural development, Mineral additives, Chemical admixtures, Cracking and Volume stability, Deterioration processes, Special concretes, Advanced Characterization Techniques, Sustainability issues in concreting, Modeling properties of concrete	6
2	**Particle packing and rheology** Advanced Mixture Design, Design Philosophy - Particle Packing & Rheology - Discrete and Continuous approach, Packing density of powders and aggregates - Experimental tests and Models, Ternary Packing Diagram, Mixture Design of Self - Compacting Concrete (SCC); Fresh Concrete Properties, Empirical test for SCC – Rheology, Basics, Parameters, Models, Rheometers, Rheology of Paste and concrete – Pumping, Setting, Curing, Plastic shrinkage, Strength Development, Maturity Method; Hardened Concrete Properties, Factors influencing strength, Interfacial Transition Zone, Stress strain relationship –Localization, End effects, Loading Conditions; Dimensional Stability, Creep and Shrinkage.	11
3	**Durability aspects of concrete** Durability, Permeability and Porosity, Chemical attack (Sulphate attack, Delayed Ettringite Formation, Chloride attack, Acid Attack, Sea Water attack, Carbonation, Freezing and Thawing, Alkali aggregate reaction, Alkali carbonate reaction Corrosion, Mode of action, failure, Tests& Protection methods.	7
4	**Rebar corrosion** Rebar Corrosion, Factors inducing rebar corrosion, electrochemical process, role of chloride in corrosion, role of carbon-di-oxide in corrosion, onset of corrosion, corrosion propagation, and service life prediction of concrete structures	4
5	**Advanced characterization techniques:** SEM, XRD, XRF *etc*. Sustainability issues in	1

	concreting	
	Total	**28**

SUGGESTED READINGS

1. Shetty, M.S. (2006). Concrete Technology, S. Chand & Comp. Ltd
2. Mehta, P.K., and Monterio, P.J. (2014). Concrete: Microstructure, Properties, and Materials, 4th Edition, McGraw-Hill Education, ISBN: 9780071797870
3. Gambhir, M.L. (2017). Concrete technology, Tata McGraw Hill, New Delhi
4. Neville, A.M. (2012). Properties of concrete, Pearson Education India
5. Bungey, J.H. (1989). Testing of Concrete in Structures, Surrey University Press, London.
6. Hewlett, P. (1998). Lea's Chemistry of Cement and Concrete, Fourth Edition, Arnold Publishers, NY.
7. Bentur, A., Diamond, S., and Berke, N.S., (1997). Steel Corrosion in Concrete, E&FN Spon, UK.
8. Taylor, H. W. F. (1990). Cement Chemistry, Academic Press, Inc., San Diego, CA.
9. Lea, F. M. (1971). The Chemistry of Cement and Concrete, Chemical Publishing Company, Inc., New York.
10. Mindess, S., and Young, J. F. (1981). Concrete, Prentice Hall, Inc., NJ.
11. Newman, J. and Choo, B. S. (2003). Advanced Concrete Technology, Four Volume Set, Elsevier.

5CE5-14: Pavement Materials

5CE5-14: Pavement Materials

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. The basic and fundamental understanding about the behavior of various materials used in the construction of pavements.
2. Characterization, tests, and engineering properties of these materials in context with its field application.
3. Current practices and future trends in pavement materials.

Course Outcomes: Upon completion of this course the students will be able to:

1. To understand the effect of various materials on the mechanical properties of properties
2. To differentiate between the different types of materials used and to design and construct road pavements
3. Using the knowledge of requirements of various materials used in pavement construction, the student will be able to think critically for the selection of alternate construction materials available locally and this formulate economical and sustainable construction practice.

S.N.	Contents	Hours
1	Soil: Introduction to soil as a highway material; Classification of soils; Consistency Limits; Soil compaction and role of moisture; Mechanical properties of soil; Introduction to expansive soils, relevant tests, and soil stabilization techniques.	5
2	Aggregates: Aggregate origin, types, production, and quarrying operation; Classification of aggregates; Aggregate gradation and gradation parameters; Theories of aggregate blending; Minerology of aggregates and its importance; Aggregate shape and texture: quantification and importance; Aggregate strength properties, and relevant tests.	5
3	Bitumen, Modified bitumen, Bitumen emulsion and Cutback bitumen: Bitumen as a binding agent; Production of bitumen; Physical and rheological properties of bitumen; Introduction to viscoelasticity; Chemistry of bitumen; Ageing of bitumen; Grading of bitumen, and relevant tests: Penetration grade, Viscosity grade, Performance grade; Bitumen modification: Need, Types and Importance; Introduction of bitumen emulsion: Theory of emulsification, Uses, Grading of emulsions, and Relevant tests; Introduction to cutback bitumen: Types, Uses, and relevant tests.	7
4	Bituminous Mixtures: Production of bituminous mixtures: Laboratory and Plant; Role of bituminous mixture and desirable properties; Volumetrics of bituminous mixture; Mix design of bituminous mixture: Marshall and Superpave methods; Mechanical tests and characterization of bituminous mixtures; Introduction to performance-based mix design concepts; Mix design of cold bituminous mixtures; Mix design of hot recycled mixtures	5
5	Cement: Cement and Cement Concrete– Desirable properties for pavements; Concrete Mix Design: Concrete proportioning and importance of various constituents; Introduction and mix design of pavement quality concrete, Dry lean concrete, and Pervious concrete Alternative Pavement Materials: State of the art on various alternative materials for construction of flexible and rigid pavements.	6
	Total	**28**

SUGGESTED READINGS

1. All relevant codes/standards from Indian Roads Congress (IRC), Bureau of Indian Standards (BIS), American Society of Testing Materials (ASTM), and American Association of State Highway and Transportation Officials (AASHTO).
2. Nikolaides, A. (2015). Highway Engineering: Pavements, Materials and Control of Quality, CRC Press, T&F.
3. Ray, E., Kandhal, P.S., Roberts, F.L., Lee, D., Brown, T.W.K. (2009). Hot Mix Asphalt Materials, Mixture Design, and Construction, NAPA Research and Education Foundation.
4. Kandhal, P.S., Veeraragavan, A., Chaudhary, R. (2023). Bituminous Road Construction in India, PHI publications.

5CE5-15: Fundamentals of Remote Sensing

5CE5-15: Fundamentals of Remote Sensing

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To get a knowledge of Physics of Remote Sensing.
2. Discuss the Data Acquisition Platforms
3. To understand the Techniques of image interpretation
4. Demonstrate and understanding the Data analysis
5. Understanding the Microwave Remote Sensing & Radar

Course Outcomes Upon completion of this course the students will be able to:

1. Select the type of remote sensing technique/data for required purpose
2. Identify the earth surface features from satellite images
3. Data Analysis methodologies
4. Gain the in-depth knowledge for data acquisition - characteristics of different types of platforms
5. Explain Microwave Remote Sensing & Radar.

S.N.	Contents	Hours
1	**Introduction and Basic Concepts**: Introduction, Basic concepts of remote sensing, Airborne and space born sensors, Passive and active remote sensing, EMR Spectrum, Energy sources and radiation principles, Energy interactions in the atmosphere, Energy interactions with earth surface features, Spectral reflectance curves	5
2	**Remote Sensing Systems**: Satellites and orbits, Polar orbiting satellites, Spectral, radiometric and spatial resolutions, Temporal resolution of satellites, Multispectral, thermal and hyperspectral sensing, Some remote sensing satellites and their features **Digital Image Processing** -Image Restoration: Geometric corrections, Co-registration of Data, Ground Control Points (GCP), Atmospheric corrections, Solar illumination corrections,	8
3	**Digital Image Processing - Image Enhancement**: Concept of color, Color Composites, Contrast stretching – linear and non-linear stretching, Filtering techniques, Edge enhancement, Density slicing, Thresholding, Intensity-Hue Saturation (IHS) images, Time composite images, Synergetic images. **Digital Image Processing – Information Extraction:** Multispectral classification, Ground truth collection, Supervised and unsupervised classification, Change detection analysis, Principal component Analysis, Ratio images, Vegetation indices	9
4	**Digital Image Processing Software**: Image processing software, Multispectral classification Algorithms, Image processing using MATLAB. **Digital Elevation Modeling**: Introduction, Sources of digital elevation data, Types of DEMs, Radar interferometry, Shuttle Radar Topographic Mission (SRTM) data	5
5	**Remote Sensing Applications:** Watershed management, Rainfall-runoff modeling, Irrigation	3

	management, Flood mapping, Drought assessment, Environmental monitoring, other applications **Advanced Topics:** Microwave remote sensing, sources of microwave data, Global positioning System (GPS), GPS for ground truth collection	
	Total	**30**

SUGGESTED READINGS

1. Campbell, J.B., and Wynne, R.H. (2011). Introduction to Remote Sensing, The Guilford Press.
2. Lillesand, T.M., and Kiefer, R.W. (2002). Remote Sensing and Image Interpretation, John Wiley & Sons, Singapore.
3. Cambell, J.B. (2002). Introduction to Remote Sensing, Taylor & Francis, UK.
4. Schowengerdt, R.A. (2006). Remote Sensing - Models and Methods for Image Processing, Elsevier India Pvt. Ltd., New Delhi.
5. Gibson, P.J. (2000). Introduction to Remote Sensing - Principles and Concepts, Routledge - Taylor & Francis.
6. Gibson, P.J. and Power, C.H. (2000). Introduction to Remote Sensing - Digital Image Processing and Applications, Routledge Taylor & Francis.
7. Elachi, C., and Zyl, J.V. (2006). Introduction to the physics and techniques of Remote Sensing, John Wiley & Sons publications.
8. Lillesand T.M & Kiefer R.W. (2008). Remote Sensing and Image Interpretation, John Wiley & Sons.
9. Matzler, C. (2006). Thermal microwave radiation: Applications for remote sensing, The institution of Engineering and Technology, London.
10. Rees, W. G. (2001). Physical Principles of Remote Sensing, Cambridge University Press.

5CE5-16: Solid Waste Management

5CE5-16: Solid Waste Management

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To educate the students on the principles involved in the management of municipal solid waste from source identification up to disposal.

Course Outcomes Upon completion of this course the students will be able to:

1. Understand the fundamentals of solid wastes and the types, needs and sources of solid wastes.
2. To understand the methods of waste characterization and source reduction and to study the various methods of generation of wastes.
3. To understand in detail about the storage, collection, and transport of wastes and to study about the methods used for handling and segregation of wastes.
4. To know about the basics of the waste disposal options and a detailed study on the disposal in landfills and to learn about landfill remediation.
5. To understand about the waste transformation and material/energy recovery technologies about municipal solid wastes

S.N.	Contents	Hours
1	Sources, Composition & Properties of solid waste, Municipal solid waste, Hazardous solid waste, Handling & Separation of solid waste, Municipal Waste (Management & Handling Rules, 2016), Integrated solid waste management (SWM) System, Hierarchical approach for SWM. Solid Waste Collection & Transportation: Types of collection systems (Hauled-container system & Stationary container system), Collection routes & their Layout, Solid waste transfer stations	7
2	Solid waste generation and collection rates; Waste handling and separation, storage and processing at source, solid wastes collection methods, separation, processing, and transformation of solid wastes; transfer and transport of solid wastes	7
3	Methods of Disposal of Municipal Solid Waste Landfills: Classification, Types & methods, Site selection, Site preparation, Composition, Characteristics, Generation, & Control of Landfill gases; Composition, Formation, Movement & control of leachate in landfills; landfill design. Re-vegetation of closed landfill sites, Long-term post closure plan, Groundwater monitoring during & after closure.	7
4	Transformation and recycling of waste materials; Composting: Theory of composting, Manual and mechanized composting, Design of composting plan, Recovery of bioenergy from organic waste. Thermal Conversion Technologies: Incineration, Pyrolysis & Gasification Systems. Types & design of Incinerators.	7
	Total	**28**

SUGGESTED READINGS

1. Tchobanoglous, G., Theisen, H., Vigil, S.A. (2014). Integrated Solid Waste Management: Engineering, Principles & Management issues, McGraw-Hill- International Edition.
2. Lagrega, M.D., Buckingham, P.L., Evans, J.C. (2001). Hazardous Waste Management and Environmental Resource Management, McGraw-Hill- International Edition.

3. Peavy, H.S., Rowe, D.R., Tchobanoglous, G. (2017). Environmental Engineering, McGraw-Hill-International Edition.
4. Davis, M.L., Cornwell, D.A. (2012). Introduction to environmental engineering, McGraw-Hill-International Edition.
5. CPHEEO Manual on Municipal Solid Waste Management.

5CE5-17: Foundation and Retaining Structures

5CE5-17: Foundation and Retaining Structures

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To know about the various types of foundations and their provision depending upon the type of soil.
2. To obtain a fundamental understanding of the concepts of foundation design.
3. To give a clear idea regarding analysis and design procedure of different types of shallow foundations.
4. To give a clear idea regarding analysis and design procedure of different types of deep foundations.
5. To give an idea regarding different types of earth retaining structures and their analysis and design procedure.

Course Outcomes: Upon completion of this course the students will be able to:

1. Learn about the different types of shallow foundations and their load carrying capacity.
2. Know about the deep foundations like pile foundation and well foundation.
3. Analysis and design procedures of different types of foundations.
4. Choose the suitable types of foundations for any structure.
5. Learn the analysis and design procedures of different types of earth retaining structure.

S.N.	Contents	Hours
1	**Foundations:** Overview on various types of foundations for Buildings, Bridges and Industrial buildings, Classification of foundations, Basis for design; Review of major soil parameters used in proportioning of foundations.	3
2	**Shallow foundations:** Selection of type and depth of foundations, Settlement calculations-Components of settlement; Limits of settlement; Accuracy in Foundation Settlement Prediction; Allowable Settlement; Allowable Soil Pressure; Estimation of settlement of footings and rafts on sands from Penetration and Plate load test data; Estimation of settlement of footing/ rafts on cohesive soils using consolidation test data; Proportioning of footings.	8
3	**Well foundations:** Situations where adopted; Elements of wells; Types; Methods of construction; Tilt and shift; Remedial measures. Proportioning- Depth and size of wells based on scour depth; Terzaghi's lateral stability analysis.	5
4	**Retaining Structure:** Earth pressure at rest; Active and passive earth pressure computations using Rankine's and Coulomb's earth pressure theories; Additional Earth pressure due to surcharge loading. Stability analysis for retaining walls; Choice of backfill material and importance of drainage. Bracing for open cuts- Recommended design diagrams of earth pressure for typical soils.	6
5	**Pile Foundation:** Introduction, Types of piles, Estimation of pile capacity by static and dynamic formulae, Methods of analysis of pile resistance, Load-transfer method of estimating pile capacity; Outline of steps involved in proportioning; Capacity and settlement of single and group of piles; Proportioning with field/lab data as input.	6
	Total	**28**

SUGGESTED READINGS

1. Bowles, J.E. (1997). Foundation Analysis and Design, McGraw-Hill, New York.
2. Murthy, V. N. S. (2017). Textbook of Soil Mechanics and Foundation Engineering, CBS Publishers &

Distributers, New Delhi.

3. Poulose, H.G. and Davis, E.H. (1980). Pile foundation Analysis and Design, John Wiley & Sons, NY.
4. Winterkorn, H.F. and Fang, H.Y. (1975). Foundation Engineering Handbook, Van Nostrand Reinhold.

5CE5-18: Introduction to Finite Element Methods

5CE5-18: Introduction to Finite Element Methods

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To understand the various numerical techniques and importance of Finite Element Method (FEM)
2. Understand the mathematical and physical principles underlying the FEM
3. To understand the importance of interpolation function in FEM
4. Be able to evaluate the 1-D structure with FEM
5. Be able to create his/her own FEM computer programs, for analysis of simple problems

Course Outcomes: Upon completion of this course the students will be able to:

1. To understand the importance of FEM over other numerical techniques.
2. To understand the importance of FEM over analytical methods and convergence requirements in FE analysis.
3. The use of various types of shape functions for FE analysis.
4. To determine displacements, stresses, and strains in 1-D problems.
5. To write computer program to evaluate displacements, stresses, and strains in 1-D problems.

S.N.	Contents	Hours
1	**Introduction to Finite Element Analysis:** Matrix Algebra, Fundamentals of continuum mechanics: Stress, displacement and strains, constitutive relationship; Background of Finite Element Analysis, Overview of Various Numerical Methods, Concepts of Elements and Nodes, Degrees of Freedom	5
2	**Boundary Value Problem** - Approximate Solution – Variational and Weighted Residual Methods - Ritz and Galerkin Formulations -Concepts of Piecewise Approximation and Finite Elements, Displacement and Shape Functions - Weak Formulation - Minimum Potential Energy	7
3	**Finite elements and interpolation functions**: Introduction, Interpolation functions- One, two and three independent spatial variables; Linear, quadratic, Cubic and Lagrange form of interpolation function, Higher order elements in one-dimension; Convergence requirement, Degree of continuity	6
4	**One-dimension finite element analysis:** Introduction, Generation of Stiffness Matrix and Load Vector, Linear spring, Truss element, Local and global element equation, Computation of stress in bar-element, Torsion of circular shaft, steady state heat conduction, flow through porous media.	5
5	**Beam element:** Review of beam theory, Finite element formulation of a beam element- Shape functions, Strain-displacement relationship, Beam stiffness matrix, load vector, Analysis of beam problem.	5
	Total	**28**

SUGGESTED READINGS

1. Reddy, J. N. (2005). An Introduction to the Finite Element Method, McGraw-Hill International Editions.
2. Desai, Y. M., Eldho, T. I., Shah, A. H. (2011). Finite Element method with Application in Engineering,

Pearson Education India.

3. Seshu, P. (2012). The Finite Element Analysis, PHI.
4. Fish, J. and Belytschko, T. (2007). A First Course in Finite Elements, John Willey & Sons.

5CE5-19: Traffic Engineering

5CE5-19: Traffic Engineering

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To provide understanding on basic traffic characteristics and various models describing the relationship among traffic stream parameters
2. To train students to collect and analyze traffic data
3. To prepare students to perform capacity and level of service analysis of a highway
4. To teach students to perform traffic signal design using IRC guidelines
5. To make students aware of traffic regulations and measures to manage traffic
6. To enable students to understand the importance of roadway safety and accident analysis

Course Outcomes: Upon completion of this course the students will be able to:

1. Describe traffic stream parameters and their relationship
2. Identify various traffic stream models and their application
3. Collect the traffic data and analyze it using statistical tools.
4. Evaluate capacity and level of service for a given highway
5. Design traffic signal using IRC guidelines
6. Describe various measures of traffic regulations and management
7. Collect the data related to accidents and identify accident hot spots

S.N.	Contents	Hours
1	**Basic Concept of Traffic Characteristics**: Traffic engineering definitions: functions, organization and importance, necessity of understanding the behavior of road user and vehicle characteristics, human factors governing the road user behavior- power performance and other vehicular characteristics. Traffic studies and surveys: Speed studies: presentation of data, journey time and delay studies, uses and various methods, relative merits and demerits Vehicular volume counts: types, various available methods, relative merits and demerits, planning of traffic counts, vehicle occupancy surveys. Origin: destination surveys, need and uses, various available methods, checks for accuracy, presentation of data. Parking surveys: needs and types. Study of various photographic techniques available for traffic studies. Traffic signs and markings: types, location, height etc., miscellaneous traffic control aids like roadway delineators, hazard markers, object marker, speed breakers, rumble strips etc., Street lighting: needs, definitions, laws of illumination, methods of discernment, glare problem, light lantern arrangement, types of lamps, planning and designing.	8
2	**Traffic Stream Models:** Introduction to traffic stream models – Greenshield's, Greenberg, Underwood, Northwestern models– Application of traffic stream models – Shock waves **Highway capacity and Level of service:** Basic definitions related to capacity – Level of service (LOS) concept – Factors affecting capacity and LOS – Computation of capacity and LOS for 2-lane highways – Multilane highways – Freeways – IRC guidelines	7
3	**Traffic Signals:** Traffic signals – Warrants for signalization – Design of traffic signal by	4

	Webster method – Signal coordination and area traffic control – IRC guidelines	
4	**Road safety: Purpose** of accident studies - Accident data collection – Identification of accident hot spots - Use of Global Positioning Systems (GPS) and Geographic Information Systems (GIS) – Causative factors of road accidents - Predictive models - Road Safety Auditing - Measures to increase Road safety.	6
5	**Intelligent Transportation Systems:** Components of ITS, Traffic Management - Incident Management, Strategies for working hours - Congestion Pricing, Advanced vehicle control and safety systems, Electronic toll collection, Traveller Information System, Benefits and costs of ITS.	5
	Total	**28**

SUGGESTED READINGS

1. Mannering, F. L., Washburn, S.S., Kilareski, W.P. (2012). Principles of Highway Engineering and Traffic Analysis, John Wiley & Sons.
2. Garber, N., Hoel, L.A. (2015). Traffic and Highway Engineering, 5th Edition, Cengage Learning, USA.
3. Kadiyali, L.R., Lal, N.B. (2011). Traffic Engineering and Transport Planning, Khanna Publishers, New Delhi, India.

5CE5-20: Geographic Information Systems

5CE5-20: Geographic Information Systems

Credit: 2Max **Marks: 100 (IA=30, ETE=70)**

2L+0T+0P **End Term Exam: 3 Hours**

Course Objectives

1. To get a knowledge of GIS terminologies.
2. To understand the Spatial Database Management Systems
3. Demonstrate and understanding the various types of Data structure and its models
4. Understanding the Spatial Analysis, Cartographic Principles and Design

Course Outcomes: Upon completion of this course the students will be able to:

1. Analyze spatial and attribute data for solving spatial problems.
2. Preparation of geospatial features in computing environment.
3. Create GIS and cartographic outputs for presentation.
4. Understand the software/hardware requirements for implementing a GIS Project.

S.N.	Contents	Hours
1	**Introduction** – GIS definition, development, application areas. Map Concept- Map-Definition, Elements of Maps, Types of maps, Advantages and disadvantages of analog/digital maps, Coordinate Systems- Geometric models of earth, Global/Local coordinate system, Projection Systems- Classification, Cylindrical projection, Conical projection, Selection of a particular projection.	7
2	**Fundamental concepts of GIS** – Modeling Real World Features- Raster data model, vector data model, Data Formats- Spatial and Non-Spatial data, Data collection and Input, Data conversion, Hardware & software Requirements. **Topology** – Editing and Error Rectification, Types of topologies, Topological Relationships.	7
3	**Spatial Analysis –** Buffer Analysis-Variations in Buffering, Applications of buffering, **Overlay Analysis –** Feature type and overlay, Vector Overlay methods, Network Analysis-Impedance, Shortest path analysis, closest facility, Concepts of Proximity analysis, Neighborhood operations.	7
4	**GIS Project Planning** – Steps in GIS project, Problem Identification and Implementation of a GIS project.	3
5	**GIS Applications** – Transportation, Water Resources, Environment, Geology, Emergency Management, Agriculture, Real Estate. **Advances in GIS** – Concepts and application of Mobile and Web GIS.	4
	Total	**28**

SUGGESTED READINGS

1. Lo, C.P., and Yeung, A.K.W. (2016). Concepts and Techniques of Geographic Information Systems, second Edition, Prentice Hall India Pvt. Ltd.
2. Burrough, P.A., and McDonnell. R.A., Lloyd, C.D. (2015). McDonnell, Principles of Geographical Information Systems, Oxford University Press.
3. Longley, P.A (2015). Geographic Information systems and Science, 4th John Wiley & Sons Edition.
4. Demers, M. N. (2002). Fundamentals of Geographic Information Systems, John Wiley & Sons, 3rd Edition.

5. Longley, P.A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W. (2005). Geographic Information Systems and Science, 2nd Edition, John Wiley & Sons.
6. Chang, K. (2018). Introduction to Geographic Information Systems, 9th Edition, Tata Mc Graw Hill Publishing Company Ltd, New Delhi.
7. Burrough, P.A. (2005). Principles of GIS for Land Resource Assessment, Oxford Publications.