Course Title: Design of RC Structural Elements

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	**15CT51**	I.A. Marks	20
Number of Lecture Hours/Week	04	Exam. Marks	80
Total Number of Lecture Hours	50	Exam. Hours	**03**
CREDITS – 04		Total Marks-100	

Course objectives: This course will enable students;

1. Identify, formulate and solve engineering problems of RC elements subjected to different kinds of loading.
2. Follow a procedural knowledge in designing various structural RC elements.
3. Impart the culture of following the codes for strength, serviceability and durability as an ethics.
4. Provide knowledge in analysis and design of RC elements for the success in competitive examinations.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1:		
Introduction to Limit State Design and Serviceability: Introduction to working stress method, Difference between Working stress and Limit State Method of design, Modular Ratio and Factor of Safety. Philosophy and principle of limit state design with assumptions. Partial Safety factors, Characteristic load and strength. Stress block parameters, concept of balanced section, under reinforced and over reinforced section. Limiting deflection, short-term deflection, long-term deflection, Calculation of deflection of singly reinforced beam only. Cracking in reinforced concrete members, calculation of crack width of singly reinforced beam. Side face reinforcement, slender limits of beams for stability.	**12 Hours**	**L1,L2**
Module -2:		
Limit State Analysis of Beams: Analysis of singly reinforced, doubly reinforced and flanged beams for flexure and shear.	**08 Hours**	**L2,L4**
Module-3:		
Limit State Design of Beams: Design of singly and doubly reinforced beams, Design of flanged beams for shear, design for combined bending and torsion as per IS-456	**10 Hours**	**L2,L4**

Module -4:		
Limit State Design of Slabs and Stairs: Introduction to one way and two-way slabs, Design of cantilever, simply supported and one-way continuous slab. Design of two-way slabs for different boundary conditions. Design of dog legged and open well staircases. Importance of bond, anchorage length and lap length.	**10 Hours**	**L2,L4**
Module -5:		
Limit State Deign of Columns and Footings: Analysis and design of short axially loaded RC column. Design of columns with uniaxial and biaxial moments, Design concepts of the footings. Design of Rectangular and square column footings with axial load and also for axial load & moment	**10 Hours**	**L2,L4**

Course outcomes:

After studying this course, students will be able to:

1. Understand the design philosophy and principles.
2. Solve engineering problems of RC elements subjected to flexure, shear and torsion.
3. Demonstrate the procedural knowledge in designs of RC structural elements such as slabs, columns and footings.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

- The question paper will have 5 modules comprising of ten questions. Each full question carrying 16 marks
- There will be two full questions (with a maximum of three subdivisions, if necessary) from each module.
- Each full question shall cover the topics as a module
- The students shall answer five full questions, selecting one full question from each module. If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.
- The designs are as per IS-456 and SP (16) relevant charts to be provided in the question paper.

Text Books:

1. Unnikrishnan Pillai and Devdas Menon, “Reinforced Concrete Design”, McGraw Hill, New Delhi
2. Subramanian, “Design of Concrete structures”, Oxford university Press
3. H J Shah, “Reinforced Concrete Vol 1 (Elementary Reinforced Concrete)”, Charotar Publishing House Pvt. Ltd.

Reference Books:

1. P C Varghese, “Limit State design of reinforced concrete” , PHI, New Delhi
2. W H Mosley, R Husle, J H Bungey, “Reinforced Concrete Design”, MacMillan Education, Palgrave publishers
3. Kong and Evans, “Reinforced and Pre-Stressed Concrete”, Springer Publications
4. A W Beeby and Narayan R S, “Introduction to Design for Civil Engineers”, CRC Press
5. Robert Park and Thomas Paulay, “Reinforced Concrete Structures”, John Wiley & Sons, Inc.

Course Title: Construction Economics and Finance

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15CT52	I.A. Marks	20
Number of Lecture Hours/Week	04	Exam. Marks	80
Total Number of Lecture Hours	50	Exam. Hours	03
CREDITS – 04		Total Marks-100	

Course objectives: This course will enable students;

1. To understand the importance of financial management in construction.
2. To determine flow statements in construction economics.
3. To ascertain and measure the financial aspect of construction projects.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1:		
INTRODUCTION Engineering economics, types of economics, Support Matters of Economy as related to Engineering, Market demand and supply, Choice of Technology, Theory of Production, Economics of Scale, Theory of Costs and Break Even Analysis.	**10 Hours**	**L1,L2,L3**
Module -2:		
CONSTRUCTION ECONOMICS Role of Civil Engineering in Industrial Development, Construction development in Housing, transport and other infrastructures, Economics of ecology, environment, energy resources. Construction workers - Urban Problems, Poverty, Unemployment Effects on economics due to migration of construction workers to urban area.	**10 Hours**	**L1,L2**
Module-3:		
CAPITAL STRUCTURE The need for financial management, Types of financing - short term borrowing, long term borrowing, leasing, equity financing – Internal generation of funds, External commercial borrowings, Assistance from government budgeting support and international finance corporations.	**10 Hours**	**L2,L3**

Module -4:		
FINANCIAL ANALYSIS Fund Flow and Cash Flow statements (Simple Problems), Financial Analysis – Meaning and Types, Tools and Techniques, Ratio Analysis, Types of Ratios, Profitability Ratio, Turnover ratio, Financial ratio (Balance sheet ratios) (Simple problems).	**10 Hours**	**L2,L3,L4,L5**
Module -5:		
WORKING CAPITAL MANAGEMENT Working Capital Management – Concept of Working Capital – Factors Affecting Working Capital – Sources of Working Capital – Forecasting The Working Capital Requirements. Liquidity and Profitability, Determination of Working Capital-Theories and Approaches	**10 Hours**	**L1,L2**

Course outcomes:

After studying this course, students will be able to:

1. Recognize the importance of working capital management and engineering economics.
2. Prepare fund flow and cash flow statements and implement in construction accounting.
3. Analyze and evaluate financial stature of construction projects.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

- The question paper will have ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- ***The students shall answer Five full questions selecting one full question from each module.***
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Reference Books:

1. Urban Economics by Warneer Z Hirsch, Macmillan, New York.
2. Financial Management, I.M. Pandey
3. P. Saravanavelu, “Management Accounting - Principles and Practice”.
4. Prof. K.S. Nagapathi “Management Accounting”, R. Chand & Co., New Delhi.

Course Title: Geotechnical Engineering [As per Choice Based Credit System (CBCS) scheme] SEMESTER – V			
Subject Code	15CT53	I.A. Marks	20
Number of Lecture Hours/Week	04	Exam. Marks	80
Total Number of Lecture Hours	50	Exam. Hours	03
CREDITS – 04		Total Marks- 100	

Course objectives: This course will enable students;

1. To understand the significance of engineering properties of soils and their relation to the formation of soils.
2. To comprehend the procedural knowledge of compaction & consolidation of soils and analyze the effects of permeability on soil behavior.
3. To apply the knowledge of shear strength of soils in the actual field conditions with respect to drainage conditions available in the field.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1:		
INTRODUCTION Introduction, origin and formation of soil, Phase Diagram, phase relationships, definitions and their interrelationships.	**03 Hours**	**L1,L2**
INDEX PROPERTIES Determination of Index Properties - Specific gravity, water content, in-situ density and particle size analysis (sieve and sedimentation analysis) Atterberg's Limits, consistency indices, relative density, activity of clay, Plasticity chart, unified and BIS soil classification.	**07 Hours**	**L1,L2,L3**

Module -2:		
SOIL STRUCTURE AND CLAY MINERALOGY Single grained, honey combed, flocculent and dispersed structures, Valence bonds, Soil-Water system, Electrical diffuse double layer, adsorbed water, base-exchange capacity, Isomorphous substitution. Common clay minerals in soil and their structures- Kaolinite, Illite and Montmorillonite and their application in Engineering.	**05 Hours**	**L1,L2,L3**
COMPACTION OF SOILS Definition, Principle of compaction, Standard and Modified proctor's compaction tests, factors affecting compaction, effect of compaction on soil properties, Field compaction control - compactive effort & method of compaction, lift thickness and number of passes, Proctor's needle, Compacting equipment's and their suitability.	**05 Hours**	**L1,L2,L3**
Module-3:		
FLOW THROUGH SOILS Darcy's law- assumption and validity, coefficient of permeability and its determination (laboratory and field), factors affecting permeability, permeability of stratified soils, Seepage velocity, superficial velocity and coefficient of percolation, Capillary Phenomena. SEEPAGE ANALYSIS- Laplace equation, assumptions, limitations and its derivation.	**06 Hours**	**L1,L2,L3**
EFFECTIVE STRESS ANALYSIS Geostatic stresses, Effective stress concept-total stress, effective stress and Neutral stress and impact of the effective stress in construction of structures, quick sand phenomena.	**04 Hours**	**L2,L3,L4**

Module -4:		
CONSOLIDATION OF SOIL Definition, Mass-spring analogy, Terzaghi's one dimensional consolidation theory - assumption and limitations. Derivation of Governing Differential Equation. Pre-consolidation pressure and its determination by Casagrande's method. Over consolidation ratio, normally consolidated, under consolidated and over consolidated soils.	**05 Hours**	**L2,L3**
Consolidation characteristics of soil (Cc, av, mv and Cv. Laboratory one dimensional consolidation test, characteristics of e-log(σ') curve, Determination of consolidation characteristics of soils- compression index and coefficient of consolidation (square root of time fitting method, logarithmic time fitting method). Primary and secondary consolidation.	**05 Hours**	**L2,L3**
Module -5:		
SHEAR STRENGTH OF SOIL Concept of shear strength, Mohr–Coulomb Failure Criterion, Modified Mohr–Coulomb Criterion, Concept of pore pressure, Total and effective shear strength parameters, factors affecting shear strength of soils. Thixotrophy and sensitivity, Measurement of shear strength parameters - Direct shear test, unconfined compression test, triaxial compression test and field Vane shear test, Test under different drainage conditions. Total and effective stress paths.	**10 Hours**	**L2,L3,L4**

Course outcomes:

After studying this course, students will be able to;

1. Describe engineering properties of soils and their relation to the formation of soils.
2. Illustrate the procedural knowledge of compaction & consolidation of soils and predict the effects of permeability on soil behavior.
3. Solve practical problems related to shear strength of soils in the actual field conditions.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- ***The students shall answer Five full questions selecting one full question from each module.***
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Reference Books:

1. Alam Singh and Chowdhary G.R. (1994), "Soil Engineering in Theory and Practice", CBS Publishers and Distributors Ltd., New Delhi.
2. Bowles, J.E. (1996), "Foundation Analysis and Designs", 5th Edition, McGraw Hill Publishing Co., New York.
3. Murthy, V.N.S. (1996), "Soil Mechanics and Foundation Engineering", 4th Edition, UBS Publishers and Distributors, New Delhi.
4. Punmia, B.C. (2003), "Soil Mechanics and Foundations", Laxmi Publishing Co., New Delhi.
5. Gopal Ranjan and Rao, A.S.R. (2000), "Basic and Applied Soil Mechanics", New Age International (P) Ltd., New Delhi.
6. Narasimha Rao A.V., and Venkatramaiah C. (2000), "Geotechnical Engineering", University press (India) Ltd., Hyderabad.

Course Title: Transportation Engineering [As per Choice Based Credit System (CBCS) scheme] SEMESTER – V			
Subject Code	15CT54	I.A. Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam. Hours	03
CREDITS – 04		Total Marks- 100	

Course objectives: This course will enable students;

1. To understand the history and development, role of railways, railway planning and development based on essential criteria's.
2. To learn different types of structural components, engineering properties of the materials in roads and railway infrastructure.
3. To calculate the material quantities required for construction of roads and design geometric elements of railway system.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1:		
PRINCIPLES OF TRANSPORTATION ENGINEERING Importance of Transportation, Different modes of transportation, characteristics and comparison of different modes, Jayakar committee recommendations and implementation.	**03 Hours**	**L1,L2**
HIGHWAY DEVELOPMENT AND PLANNING Road Types and classification, road patterns. Planning surveys, Master plan - saturation system of road planning, phasing road development programme Road Development in India, 1st, 2nd & 3rd 20-year road development plan and problems only on 3rd 20-year road plan. Present scenario of road development in India (NHDP & PMGSY) and in Karnataka (KSHIP & KRDCL) – problems on best alignment among alternate proposals and phasing, Road Development Plan Vision 2021.	**07 Hours**	**L2,L3**

Module -2:		
HIGHWAY ALIGNMENT AND SURVEYS Ideal alignment, factors affecting alignment, engineering surveys for new and realignment projects.	**03 Hours**	**L1,L2**
HIGHWAY GEOMETRIC DESIGN Importance, Factors controlling the design of geometric elements, highway cross section elements – pavement surface characteristics, camber, width of carriageway, shoulder width, formation width, right of way, typical cross section of roads. Sight distance, Types and importance - Design of horizontal and vertical alignment – Numerical problems on above (No derivation of formulae)	**07 Hours**	**L2,L3**
Module -3:		
PERMANENT WAY Role of railways in transportation, Indian Railways, selection of routes. Introduction to Permanent Way, requirements for an ideal permanent way, typical cross sections of single and double line B.G. tracks – in cutting, embankment and electrified tracks. Gauges and types of gauges with dimensions. Coning of wheels and tilting of rails. Track stresses in rails, sleepers, ballast and subgrade. Problems on these. Rails functions requirements, types of rail sections, length of rails, defects in rails. Wear on rails, rail joints, welding of rails, creep of rails.	**10 Hours**	**L1,L2,L3,L4**

Module-4:		
BALLAST AND SLEEPERS Functions, requirements, types, track fittings and fasteners, calculation of quantity of materials needed for laying a track. Traction and tractive resistances, tractive power, Hauling capacity. Problems on above. **GEOMETRIC DESIGN OF TRACK** Necessity of Geometric Design of railway track, gradient and types of gradient. Speed of train, curve, transition curve, super elevation, cant - deficiency, negative cant- speed calculation based on Indian Railways Formulae for High speed tracks only-problems on above.	**10 Hours**	**L1,L2,L3,L4**

Module -5:		
POINTS AND CROSSING Necessity and its components, turnout, design of turnout, Types of switches, crossings, track junctions. Stations and yards, marshalling yard, signalling and interlocking, track defects, track maintenance, level crossing, Indian Railway standards (no derivations, only relevant problems). Equipment in stations and yards such as turn-table, water columns, fouling marks, buffer stops etc.	**10 Hours**	**L1,L2**

Course outcomes:

After studying this course, students will be able to;

1. Identify different modes of transportation and planning stages for highways.
2. Acquires capability of choosing alignment and design geometric aspects of railway system, runway and taxiway.
3. Suggest and estimate the material quantity required for laying a railway track and will be able to determine the hauling capacity of a locomotive.

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- ***The students shall answer Five full questions selecting one full question from each module.***
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Highway Engineering- Khanna, S.K. & Justo, C.E.G., Nem Chand & Bros, Roorkee (2003).
2. Highway Engineering- Kadiyali, L.R., Khanna Publishers, New Delhi.
3. Railway Engineering- Saxena and Arora, Dhanpat Rai and Sons, New Delhi.
4. Railway Engineering- Satish Chandra & Agarwal, M.M., Oxford University Press, New Delhi
5. Indian railway Track, Agarwal M.M, Jaico Publications, Bombay.

Course Title: Air Pollution and Control

Professional Elective-1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15CT551	I.A. Marks	20
Number of Lecture Hours/Week	03	Exam. Marks	80
Total Number of Lecture Hours	50	Exam. Hours	03
CREDITS – 03		Total Marks- 100	

Course objectives: This course will enable students;

1. Study the sources and effects of air pollution
2. Learn the meteorological factors influencing air pollution.
3. Analyze air pollutant dispersion models
4. Illustrate particular and gaseous pollution control methods.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1:		
Introduction: Definition, Sources, classification and characterization of air pollutants. Effects of air pollution on health, vegetation & materials. Types of inversion, photochemical smog.	**08 Hours**	**L1,L2**
Module -2:		
Meteorology: Temperature lapse rate & stability, wind velocity & turbulence, plume behavior, measurement of meteorological variables, wind rose diagrams, Plume Rise, estimation of effective stack height and mixing depths. Development of air quality models-Gaussian dispersion model.	**08 Hours**	**L1,L2,L3**
Module -3:		
Sampling: Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants (PM2.5, PM10, SOX,NOX, CO, NH3)	**08 Hours**	**L2,L3,L4**
Module -4:		
Control Techniques: Particulate matter and gaseous pollutants- settling chambers, cyclone separators, scrubbers, filters & ESP.	**08 Hours**	**L3,L4**
Module -5:		
Air pollution due to automobiles, standards and control methods. Noise pollution causes, effects and control, noise standards. Environmental issues, global episodes, laws, acts, protocols	**08 Hours**	**L3,L4**

Course outcomes:

After studying this course, students will be able;

1. Identify the major sources of air pollution and understand their effects on health and environment.
2. Evaluate the dispersion of air pollutants in the atmosphere and to develop air quality models.
3. Ascertain and evaluate sampling techniques for atmospheric and stack pollutants.
4. Choose and design control techniques for particulate and gaseous emissions.

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- ***The students shall answer Five full questions selecting one full question from each module.***
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. M. N. Rao and H V N Rao, "Air pollution", Tata Mc-Graw Hill Publication.
2. H. C. Perkins, "Air pollution". Tata McGraw Hill Publication
3. Mackenzie Davis and David Cornwell, "Introduction to Environmental Engineering" McGraw-Hill Co.

Reference Books:

1. Noel De Nevers, "Air Pollution Control Engineering", Waveland Pr Inc.

2. Anjaneyulu Y, "Text book of Air Pollution and Control Technologies", Allied Publishers

Course Title: Advance Surveying

Professional Elective-1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15CT552	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS – 03		Total Marks-100	

Course objectives: This course will enable students to:

1. Gain the knowledge of principles to arrive at solutions to surveying problems.
2. Analyze spatial data using appropriate computational and analytical techniques.
3. Use the concepts of advanced data capturing methods necessary for engineering practice.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
THEORY OF ERRORS AND TRIANGULATION ADJUSTMENT Errors and classification of errors Precision and accuracy, Laws of weights and accidental errors. **PROBABILITY** Probability distribution function and density function-normal distribution. RMS error - measure of precision. Rejection of observations-principles of least squares - Normal equations.	**08 Hours**	**L1,L2**

Module -2		
METHOD OF CORRELATES Triangulation adjustment. Angle adjustment, station adjustment and figure adjustment. **HYDROGRAPHIC SURVEYING** Methods of soundings. Instruments. Three-point problem. Tidal and Stream discharge measurement	**08 Hours**	**L2,L3**
Module -3		
ELECTRONIC DISTANCE MEASUREMENT (EDM): Introduction, Electro Magnetic (EM) Waves. Phase comparison and modulations. Instruments – Geodimeter – Tellurimeter – Distomat – Range finders – Radars. Introduction to GPS Total station.	**08 Hours**	**L1,L2, L3**

Module -4		
FIELD ASTRONOMY Earth celestial sphere. Solar system Position by altitude and azimuth system-spherical triangle and spherical trigonometry. Astronomical triangle. Nepiers rule.	**04 Hours**	**L2,L3**
TIME Siderial time, day and year-solar time and day-Greenwich mean time-standard time. Meridian and azimuth-their determination-latitude and its determination.	**04 Hours**	**L2,L3**
Module -5:		
SETTING OUT WORKS Introduction. Setting out of buildings, culverts, bridge, pipeline and sewers, tunnels.	**08 Hours**	**L2,L3**

Course outcomes:

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

1. Reproduce the knowledge of geometric principles to arrive at surveying problems
2. Analyze spatial data using appropriate computational and analytical techniques with aid of electronic instruments.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer Five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Surveying Vol I, II & III- Punmia. B.C. - Lakshmi Publications, New Delhi.
2. Surveying Vol I & II- Duggal S.K. - Tata Mc Graw-Hill publishing Co.,
3. Surveying Levelling-Part I & II – Kanitkar T.P. & Kulkarni S.V. – Pune Vidhyarthi Gruha Prakashana.

REFERENCE BOOKS:

1. Introduction to Surveying- James, M. Anderson and Edward, M. Mikhail – Mc Graw Hill Book Co., 1985.
2. Analysis and survey measurements- M. Mikhalil and Gracie, G. - Van Nostrand Reinhold Co., (NY)-1980.
3. Plane and Geodetic Surveying for Engineers - David Clark -Vol I & II-CBS publishers and distributors, New Delhi.

Course Title: Building Planning and Standards Professional Elective-1 [As per Choice Based Credit System (CBCS) scheme] SEMESTER – V			
Subject Code	15CT553	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS – 03		Total Marks-100	

Course objectives:

This course will enable students to:

1. Gain the knowledge of types of building and their standards for building planning and construction.
2. Understand the building components for planning and functional design of public buildings.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
INTRODUCTION Terminologies, Requirement of parts of building, building component standards, Sizes of parts of building, Positioning of various components of buildings, orientation of buildings, set back distances and calculation of carpet area, plinth area and floor area ratio (simple problems).	**10 Hours**	**L1,L2,L3**
Module -2		
BASIC PARAMETERS OF PLANNING Principles of site selection, Site plan, Principles of Planning, Essential factors of planning, Consideration of Architectural design – Bye laws of locality, climate and its effects, materials and methods of construction, people and their requirements, State building Bye-Law's.	**10 Hours**	**L1,L2**

Module -3		
BUILDING TYPES AND STANDARDS Building types – Private, public, commercial, industrial, Planning criteria pertaining to various cases. Building Standards for Residential Buildings, Hospitals, Educational / Schools, Public offices, Commercial Buildings.	**10 Hours**	**L1,L2**
Module -4		
RURAL HOUSING STANDARDS Village planning, Components or rural house, Typical modern village plan, Rural house specifications – foundation and plinth, DPC, Superstructure, Doors and Windows, roofs, flooring, plastering and finishing, Bye-Laws for rural housing.	**10 Hours**	**L1,L2**
Module -5:		
Functional design of building using inter connectivity diagrams (bubble diagram), development of line diagram only for following building i) Primary health centre, ii) Primary school building, iii) College canteen iv) Office building v) Rural house (2 rooms quarter)	**10 Hours**	**L2,L3**

Course outcomes:

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

1. Select building type and their standards for planning and construction.
2. Outline the building components for planning and functional design of public buildings.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer Five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

REFERENCE BOOKS:

1. IS 1256-1967
2. National Building Code, BIS, New Delhi.
3. G.S. Birdie: “Estimating and Costing”, Dhanpat Rai Publishing Company, New Delhi.
4. Gurucharan Singh: “Building Construction”, Standard Publishers and Distributors, New Delhi.
5. Sushil Kumar “Building Construction”, Lakshmi Publishers, New Delhi.
6. Chiara and callender (Ed) – Time Saver Standards for Building Types, McGraw Hill
7. Poulhans Peters (Ed) – Design and Planning series (i) Factories (ii) New Schools (iii) Laboratories (iv) Centres for storage and distributors – Van Nostrand
8. M.F. Schmertz (Ed) – Office Building Design – II Ed., McGraw Hill.
9. Edward D. Mills – Planning Buildings for Administration, Entertainment and recreation – Newnes Butterworth.
10. Kunders – Hospital Planning, Design and Management, Book Base

Course Title: Fundamentals of Architecture

Professional Elective-1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15CT554	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
CREDITS – 03		Total Marks-100	

Course objectives:

This course will enable students:

1. To remember the basic components for architectural design in building construction.
2. To understand the physical and aesthetic experience of buildings in order to appreciate the complexity of the influences bearing on architecture, as reflected in the major historical periods.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
INTRODUCTION Aim and importance of architecture; Perceptions of architecture by Architects, Definitions, Architectural composition and analysis – Terms associated with qualities, The aesthetic and functional components.	**08 Hours**	**L1,L2**
Module -2		
INFLUENCES OF THE FOLLOWING ON ARCHITECTURE Association, tradition, climate, materials, topography, religion, social customs and aspirations of the times. Various factors influencing the architecture of a region, architecture as a response to social, technological and environment forces. Evolution of shelter forms in regions of the world and examples of vernacular architecture in the world, with particular reference to India.	**08 Hours**	**L1,L2**

Module -3		
INDIAN ARCHITECTURE Historical perspective – Hindu, Jain, Buddhist, Indo-saracenic and colonial. Features, characteristics and analysis.	**08 Hours**	**L1,L2**
Module -4		
WORLD ARCHITECTURE Greek, Roman, Egyptian and Saracenic – Epochs in world architecture, Description and examples	**08 Hours**	**L1,L2**
Module -5:		
MODERN ARCHITECTURE Modern movements and modern architecture, Post-independence Architecture in India, Influences, trends and developments important Indian architects and their works, Examples of noted Indian architectural works.	**08 Hours**	**L2,L3**

Course outcomes:

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

1. Describe the basic components for architectural design in building construction.
2. Distinguish the physical and aesthetic experience of buildings in order to appreciate the complexity of the influences bearing on architecture globally.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum Three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- The students shall answer Five full questions selecting one full question from each module.
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

REFERENCE BOOKS:

1. Indian Architecture by Percy Brown, Vol. 1 & II., Tarapore Publishers, Bombay, 1981.
2. History of Architecture by Fletcher, CBS Publishers, Delhi, 1983.

Course Title: Engineering Ethics

Open Elective 1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15CT561	I.A. Marks	20
Number of Lecture Hours/Week	03	Exam. Marks	80
Total Number of Lecture Hours	40	Exam. Hours	03
CREDITS – 03		Total Marks-100	

Course objectives: This course will enable students:

1. To enable the students to create an awareness on Engineering Ethics and Human Values
2. To instill Moral and Social Values and Loyalty and to appreciate the rights of others.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1:		
HUMAN VALUES Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.	**8 Hours**	**L1,L2**
Module -2:		
ENGINEERING ETHICS Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.	**8 Hours**	**L1,L2**
Module-3:		
ENGINEERING AS SOCIAL EXPERIMENTATION Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.	**8 Hours**	**L1,L2**

Module -4:		
SAFETY, RESPONSIBILITIES AND RIGHTS Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.	**8 Hours**	**L1,L2**
Module -5:		
GLOBAL ISSUES Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.	**8 Hours**	**L1,L2**

Course outcomes:

After studying this course, students will be able to;

1. State the ethics in society and discuss the ethical issues related to engineering.
2. Recognize the responsibilities and rights in the society related to engineering.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- ***The students shall answer Five full questions selecting one full question from each module.***
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

TEXTBOOK

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.

Reference Books:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics –Concepts and Cases”, Thompson Wadsworth, A Division of Thomson Learning Inc.,United States, 2000
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundametals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

Course Title: SPECIAL CONCRETE

Open Elective 1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15CT562	I.A. Marks	20
Number of Lecture Hours/Week	04	Exam. Marks	80
Total Number of Lecture Hours	40	Exam. Hours	03
CREDITS – 03		Total Marks-100	

Course objectives: This course will enable students:

1. To gain the fundamental knowledge of various special concrete over conventional concrete.
2. To comprehend the various properties of special concrete and conventional concrete.
3. To apply the codal procedural knowledge for calculation of mix proportions for various special concrete.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1:		
INTRODUCTION Fundamentals of concrete technology in relation to special concrete requirements, types of special concretes and their applications. **FIBER REINFORCED CONCRETE** Fiber material, mix proportions, fiber content – distribution, orientation and interfacial bond. Fiber concrete properties in fresh state. Strengthen behavior in tension, compression and bending. Toughness and related tests, Mix design criteria and application.	**8 Hours**	**L2,L3**
Module -2:		
HIGH DENSITY CONCRETE Materials, placement method, properties in wet and hardened state, Mix design criteria and applications **SELF COMPACTING CONCRETE** Introduction, Properties, Test methods and its application.	**8 Hours**	**L2,L3**

Module-3:		
LIGHTWEIGHT CONCRETE Classification, Properties of lightweight concrete, Strength and durability, Design of lightweight concrete mixes. **POLYMER CONCRETE** Materials, Types, Properties, Mix design criteria and its applications	**8 Hours**	**L2,L3**
Module -4:		
HIGH STRENGTH CONCRETE General introduction, significance of HSC, methods of making HSC, materials and mix proportions. Application of HSC, Ultra HSC, Methods of making Ultra HSC.	**8 Hours**	**L2,L3**
Module -5:		
HIGH PERFORMANCE CONCRETE General introduction and significance of HPC. Mix design criteria using plasticizes, SP, HP, Pozzolanic materials such as fly ash, ground granulated blast furnace slag, silica fumes, Metakaolin rice husk ash.	**8 Hours**	**L2,L3**

Course outcomes:

After studying this course, students will;

1. Acquire the knowledge of various special concrete over conventional concrete.
2. Compare the various properties of special concrete with conventional concrete.
3. Design the mix proportions for special concrete as per relevant codal standards.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- ***The students shall answer Five full questions selecting one full question from each module.***
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Reference Books:

1. Concrete Microstructures, Properties and Materials by P.K. Mehta, and Paulo J.M., Monteiro, Indian Edition.
2. Properties of Concrete by A.M. Neville, Longmans, 4th Edition, 1995
3. Relevant National, International Codes, Technical Papers and Internet Information for Special Concrete.

Course Title: Remote Sensing and GIS

Open Elective 1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15CT563	I.A. Marks	20
Number of Lecture Hours/Week	04	Exam. Marks	80
Total Number of Lecture Hours	40	Exam. Hours	03
CREDITS – 03		Total Marks-100	

Course objectives: This course will enable students;

1. Understand the basic concepts of remote sensing.
2. Analyze satellite imagery and extract the required units.
3. Extract the GIS data and prepare the thematic maps.
4. Use the thematic maps for various applications.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1:		
Remote Sensing:-Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features(soil, water, vegetation),Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.	**8 Hours**	**L1,L2,L3**
Module -2:		
Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms- IRS, Landsat, SPOT, Cartosat, Ikonos, Envisat etc. Sensors-active and passive, MSS, AVHRR, LISS, TM, PAN, WIFS, microwave sensors, sensor resolutions (spatial, spectral, radiometric and temporal). Basics of digital image processing- radiometric and geometric corrections. Image enhancements, image transforms based on arithmetic operations, image filtering.	**8 Hours**	**L2, L3,L4**

Module-3:		
Geographic Information System: Introduction to GIS; components of a GIS ; Geo spatial Data: Spatial Data- Attribute data-Joining Spatial and attribute data; GIS Operations: Spatial Data Input – Attribute data Management -Data display Data Exploration – Data Analysis. Coordinate Systems: Geographic coordinate System: approximation of the Earth, Datum; Map Projections: Types of Map Projections – Map projection parameters – Commonly used Map Projections- Projected coordinate Systems.	**8 Hours**	**L2, L3,L4**
Module -4:		
Vector and Raster Data Model: Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Data models for composite feature Objects based Vector Data Model. Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data conversion, Integration of Raster and Vector data.	**8 Hours**	**L3,L4,L5**
Module -5:		
Integrated Applications of Remote sensing and GIS: Applications in land use, land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management.	**8 Hours**	**L3,L4,L5**

Course outcomes:

At the end of the course, the student will be able to:

1. Collect data and delineate various elements from the satellite imagery using their spectral signature.
2. Analyze different features of ground information to create raster or vector data.
3. Perform digital classification and create different thematic maps for solving specific problems
4. Make decision based on the GIS analysis on thematic maps.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- ***The students shall answer Five full questions selecting one full question from each module.***
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Text Books:

1. Narayan Panigrahi, **"Geographical Information Science**", ISBN 10: 8173716285 / ISBN 13: 9788173716287, University Press 2008.
2. Basudeb Bhatta, **"Remote sensing and GIS"**, ISBN:9780198072393, Oxford University Press 2011
3. Kang – Tsurg Chang, **"Introduction to Geographic Information System".** Tata McGraw Hill Eduction Private Limited 2015.
4. Lillesand, Kiefer, Chipman, "**Remote Sensing and Image Interpretation**", Wiley 2011.

Reference Books:

1. Chor Pang Lo and Albert K.W Yeung, "Concepts & Techniques of GIS", PHI, 2006
2. John R. Jensen, "Remote sensing of the environment", An earth resources perspective – 2nd edition – by Pearson Education 2007.
3. Anji Reddy M., "Remote sensing and Geograperhical information system", B.S. Publications 2008.
4. Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geo physical Information system", Oxford Publications 2004.

Course Title: CLIMATE CHANGE AND SUSTAINABLE DEVELOPMENT

Open Elective 1

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15CT564	I.A. Marks	20
Number of Lecture Hours/Week	04	Exam. Marks	80
Total Number of Lecture Hours	40	Exam. Hours	03
CREDITS – 03		Total Marks-100	

Course objectives: This course will enable students;

1. Identify the factors influencing the global climate systems and clean technologies for sustainable development
2. Assess the impacts of climate change on global, regional and local scales.
3. Develop strategies for adaptation and mitigation measures.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1:		
EARTH'S CLIMATE SYSTEM Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes – The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation - The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.	**9 Hours**	**L1,L2**
Module -2:		
CLIMATE CHANGES AND ITS CAUSES Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modelling.	**8 Hours**	**L1,L2**

Module-3:		
IMPACTS OF CLIMATE CHANGE Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions– Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.	**7 Hours**	**L1,L2**
Module -4:		
CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS)- Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.	**9 Hours**	**L2,L3**
Module -5:		
CLEAN TECHNOLOGY AND ENERGY Clean Development Mechanism –Carbon Trading- examples of future Clean Technology – Biodiesel – Natural Compost – Eco-Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydropower – Mitigation Efforts in India and Adaptation funding.	**7 Hours**	**L2,L3**

Course outcomes:

At the end of the course, the student will be able to:

1. Identify the factors influencing the global climate systems and clean technologies for sustainable development
2. Assess the impacts of climate change on global, regional and local scales.
3. Develop strategies for adaptation and mitigation measures.

Program Objectives (as per NBA)

- Engineering Knowledge.
- Problem Analysis.

Question paper pattern:

- The question paper will have Ten questions, each full question carrying 16 marks.
- There will be two full questions (with a maximum three sub divisions, if necessary) from each module.
- Each full question shall cover the topics under a module.
- ***The students shall answer Five full questions selecting one full question from each module.***
- If more than one question is answered in modules, best answer will be considered for the award of marks limiting one full question answer in each module.

Reference Books:

1. Anil Markandya, Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002

2. Heal, G. M., Interpreting Sustainability, in Sustainability: Dynamics and Uncertainty, Kluwer Academic Publ., 1998

3. Jepma, C.J., and Munasinghe, M., Climate Change Policy – Facts, Issues and Analysis, Cambridge University Press, 1998

4. Munasinghe, M., Sustainable Energy Development: Issues and Policy in Energy, Environment and Economy: Asian Perspective, Kleindorfor P. R. et. al (ed.), Edward Elgar, 1996

5. Dash Sushil Kumar, "Climate Change – An Indian Perspective", Cambridge University Press India Pvt. Ltd, 2007

Course Title: Computer Aided Building Drawing

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15CTL57	I.A. Marks	20
Number of Lecture Hours/Week	03 (1hr Instructions + 2hr Drawing)	Exam. Marks	80
Total Number of Lecture Hours	42	Exam. Hours	03
CREDITS – 02		Total Marks-100	

Course objectives: This course will enable students;

1. Understand the details of construction of different building elements.
2. Visualize the completed form of the building and the intricacies of construction based on the engineering drawings in software.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1:		
Basics of AUTOCAD: *Drawing tools:* Lines, Circle, Arc, Polyline, Multiline, Polygon, Rectangle, Spline, Ellipse *Modifying tools*: Erase, Copy, Mirror, Offset, Array, Move, Rotate, Scale, Stretch, Lengthen, Trim, Extend, Break, Chamfer and Fillet *Using Text*: Single line text, Multiline text, Spelling, Edit text, *Special Features*: View tools, Layers concept, Dimension tools, Hatching, Customizing toolbars, Working with multiple drawings	**06 Hours**	**L1,L2**
Module -2:		
Use of AUTOCAD in Civil Engineering Drawings: Drawings Related To Different Building Elements: i) Cross section of Foundation - masonry wall, Isolated RCC columns ii) Different types of staircases(Dog-legged and open well) iii) RCC - Lintel and Chejja iv) Doors – Two Panelled, Glazed and Partially Glazed. v) RCC slabs (Simply supported-discontinuous- One-Way & Two Way slab) and beams.	**24 Hours**	**L2,L3**

Module -3:		
Building Drawings: Drawing of Plan, elevation and sectional elevation of single storied and two storied residential building given the single line diagram	**12 Hours**	**L2,L3**

Course outcomes:

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

1. Prepare, read and interpret the drawings in a professional set up.
2. Plan and design a residential or public building as per the given requirements with software aid.

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

· There will be two full questions with sub divisions if necessary from Module 2 with each full question carrying **thirty** marks. Students have to answer one question.

· There will be one compulsory full question from Module 3 carrying **fifty** marks.

REFERENCE BOOKS:

1. Computer Aided Design Laborator- Dr M.N.Shesha Prakash, Dr.G.S.Suresh, Lakshmi Publications

2. CAD Laboratory- M.A.Jayaram, D.S.Rajendra Prasad- Sapna Publications

Course Title: Geotechnical Engineering Laboratory

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – V

Subject Code	15CTL58	I.A. Marks	20
Number of Lecture Hours/Week	03 (1hr tutorial + 2hr laboratory)	Exam. Marks	80
Total Number of Lecture Hours	42	Exam. Hours	03
CREDITS – 02		Total Marks-100	

Course Objectives: Provide students with a basic understanding;

1. To carry out laboratory tests and to classify soil as per IS codal procedures.
2. To conduct experiments to determine hydraulic conductivity and degree of compaction of soil.
3. To perform tests to determine shear strength and consolidation characteristics of soils.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Exercise -1:		
Tests for determination of specific gravity and moisture content	**3**	**L2,L3,L4**
Exercise -2:		
Grain Size analysis of soil samples (Sieve analysis)	**3**	**L2,L3,L4**
Exercise -3:		
In situ density by core cutter and sand replacement methods	**3**	**L2,L3,L4**
Exercise -4:		
Consistency limits – Liquid limit (Casagrande and cone penetration methods), plastic limit and shrinkage limit	**6**	**L2,L3,L4**
Exercise -5:		
Standard proctor compaction test and modified proctor compaction test	**6**	**L2,L3,L4**
Exercise -6:		
Coefficient of permeability by constant head and variable head methods	**3**	**L2,L3,L4**
Exercise -7:		
Strength tests 7.1 Unconfined compression test 7.2 Direct shear test 7.3 Triaxial compression test (Undrained)	**9**	**L2,L3,L4**
Exercise -8:		
Consolidation test – Determination of compression index and coefficient of consolidation	**3**	**L2,L3,L4**

Exercise -9:		
Demonstration of 9.1 Miscellaneous equipment's such as augers, samplers, rapid moisture meter, Proctor's needle 9.2 Free swell index test 9.3 Determination of relative density of sand 9.4 Plate Load Test 9.5 Standard Penetration Test 9.6 Cone (Dynamic & static) Penetration Test 9.7 Seismic Refraction Method 9.8 Rock Quality Designation	**6**	**L1,L2**

Course outcomes:

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

1. Reproduce procedural knowledge of laboratory tests and to identify soil as per IS codal procedures.
2. Determine index properties of soil as per IS codal procedures

Program Objectives (as per NBA)

- *Engineering Knowledge.*
- *Problem Analysis.*

Question paper pattern:

- All experiments are to be included in the examination except demonstration exercises.
- Candidate to perform experiment assigned to him
- Marks are to be allotted as per the split up of marks shown on the cover page of answer script

Reference Books:

1. Punmia B C, Soil Mechanics and Foundation Engineering- (2017), 16th Edition, Laxmi Publications co., New Delhi.
2. Lambe T W “Soil Testing for Engineers”, Wiley Eastern Ltd, New Delhi.
3. Head K H (1986) “Manual of soil laboratory testing”, Vol I, II and III, Pentech Press, London.
4. Bowles J E (1988) “Engineering Properties of soils and their measurements”, McGraw Hill Book Co, New York
5. Relevant BIS Codes of Practice: 2720(Part-3/Sec. 1) – 1987; IS 2720 (Part – 2)- 1973; IS 2720 (Part – 4) –1985; IS 2720 (Part – 5) – 1985; IS 2720 (Part – 6) – 1972; IS 2720 (Part – 7) – 1980; IS 2720 (Part – 8) –1983; IS 2720 (Part – 17) – 1986; IS 2720 (Part - 10) – 1973; IS 2720 (Part – 13) – 1986; IS2720 (Part 11) –1971; IS2720 (Part 15) – 1986; IS 2720 (Part 30) – 1987; IS 2720 (Part 14) – 1977; IS 2720 (Part – 14) – 1983;IS 2720 (Part – 28) – 1974; IS 2720 (Part – 29) – 1966, IS 2720 (Part-60) 1965.