Course Title: Design of RC Structural Elements

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

SEMESTER:V

Subject Code	15CV51	IA 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 to

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	L_1, L_2
Module -2		
Limit State Analysis of Beams: Analysis of singly reinforced, doubly reinforced and flanged beams for flexure and shear	8 Hours	L_2, L_4
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	L_2, L_4
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	L_2, L_4

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	L_2, L_4

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
4. owns professional and ethical responsibility

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

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 con crete" , PHI, New Delhi
2. W H Mosley, R Husle, J H Bungey, "Reinforced Concre te Design", MacMillan Education, Palgrave publisher s
3. Kong and Evans, "Reinforced and Pre-Stressed Concre te", 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: Analysis of Indeterminate Structures

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

SEMESTER:V

Subject Code	15CV52	IA 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 to

1. Ability to apply knowledge of mathematics and engineering in calculating slope, deflection, bending moment and shear force using slope deflection, moment distribution method and Kani's method.
2. Ability to identify, formulate and solve problems in structural analysis.
3. Ability to analyze structural system and interpret data.
4. Ability to use the techniques, such as stiffness and flexibility methods to solve engineering problems
5. Ability to communicate effectively in design of structural elements

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Slope Deflection Method: Introduction, sign convention, development of slope deflection equation, analysis of continuous beams including settlements, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3	10 hours	L_2, L_4,L_5
Module -2		
Moment Distribution Method: Introduction, Definition of terms, Development of method, Analysis of continuous beams with support yielding, Analysis of orthogonal rigid plane frames including sway frames with kinematic indeterminacy ≤ 3	08 Hours	L_2, L_4,L_5
Module -3		
Kani's Method: Introduction, Concept, Relationships between bending moment and deformations, Analysis of continuous beams with and without settlements, Analysis of frames with and without sway	08 Hours	L_2, L_4,L_5
Module -4		
Matrix Method of Analysis (Flexibility Method) : Introduction, Axes and coordinates, Flexibility matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with static indeterminacy ≤ 3	12 Hours	L_2, L_4,L_5
Module -5		
Matrix Method of Analysis (Stiffness Method): Introduction, Stiffness matrix, Analysis of continuous beams and plane trusses using system approach, Analysis of simple orthogonal rigid frames using system approach with kinematic indeterminacy ≤ 3	12 Hours	L_2, L_4,L_5

Course outcomes: After studying this course, students will be able to:

1. Determine the moment in indeterminate beams and frames having variable moment of inertia and subsidence using slope defection method
2. Determine the moment in indeterminate beams and frames of no sway and sway using moment distribution method.
3. Construct the bending moment diagram for beams and frames by Kani's method.
4. Construct the bending moment diagram for beams and frames using flexibility method
5. Analyze the beams and indeterminate frames by system stiffness method.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

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.

Text Books:

1. Hibbeler R C, **" Structural Analysis",** Pearson Publication
2. L S Negi and R S Jangid, **"Structural Analysis",** Tata *McGraw-Hill* Publishing Company Ltd.
3. D S Prakash Rao, **"Structural Analysis: A Unified Approach"** , Universities Press
4. K.U. Muthu, H.Narendra etal, **"Indeterminate Structural Analysis",** IK International Publishing Pvt. Ltd.

Reference Books:

1. Reddy C S, **"Basic Structural Analysis"** , *Tata McGraw-Hill* Publishing Company Ltd.
2. Gupta S P, G S Pundit and R Gupta, **"Theory of Structures** ", Vol II, Tata McGraw Hill Publications company Ltd.
3. V N Vazirani and M M Ratwani, **"Analysis Of Structures** ", Vol. 2, Khanna Publishers
4. Wang C K, **"Intermediate Structural Analysis",** McGraw Hill, International Students Edition.
5. S.Rajasekaran and G. Sankarasubramanian, **"Computational Structural Mechanics",** PHI Learning Pvt. Ltd.,

Course Title: Applied Geotechnical Engineering

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

SEMESTER:V

Subject Code	15CV53	IA 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 to

1. Appreciate basic concepts of soil mechanics as an integral part in the knowledge of Civil Engineering. Also to become familiar with foundation engineering terminology and understand how the principles of Geotechnology are applied in the design of foundations
2. Learn introductory concepts of Geotechnical investigations required for civil engineering projects emphasizing in-situ investigations
3. Conceptually learn various theories related to bearing capacity of soil and their application in the design of shallow foundations and estimation of load carrying capacity of pile foundation
4. Estimate internal stresses in the soil mass and application of this knowledge in proportioning of shallow and deep foundation fulfilling settlement criteria
5. Study about assessing stability of slopes and earth pressure on rigid retaining structures

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Soil Exploration: Introduction, Objectives and Importance, Stages and Methods of exploration- Test pits, Borings, Geophysical methods, stabilization of boreholes, Sampling techniques, Undisturbed, disturbed and representative samples, Geophysical exploration and Bore hole log. Drainage and Dewatering methods, estimation of depth of GWT (Hvorslev's method).	**10 Hours**	**L1,L2,L3**
Module -2		
Stress in Soils: Introduction, Boussinesq's and Westergaard's theo ry - concentrated load, circular and rectangular load, equivalent point load method, pressure distribution diagrams and contact pressure, Newmark's chart Foundation Settlement - Approximate method for stress distribution on a horizontal plane, Types of settlements and importance, Computation of immediate and consolidation settlement	**10 Hours**	**L2,L3,L4**
Module -3		
Lateral Earth Pressure: Active, Passive and earth pressure at rest, Rankine's theory for cohesionless and cohesive soils, Coulomb's theory, Rebhann's and Culmann's graphical construction. **Stability of Slopes :** Assumptions, infinite and finite slopes, factor of safety, use of Taylor's stability charts, Swedish slip circle method for C and C-ϕ (Method of slices) soils, Fellineous method for critical slip circle	**10 Hours**	**L2,L4,L5**

Module -4		
Bearing Capacity of Shallow Foundation: Types of foundations, determination of bearing capacity by Terzaghi's and BIS method (IS: 6403), Effect of water table and eccentricity, field methods - plate load test and SPT Proportioning of shallow foundations- isolated and combined footings (only two columns)	**10 Hours**	**L2,L4,L5,L6**
Module -5		
Pile Foundations: Types and classification of piles, single loaded pile capacity in cohesionless and cohesive soils by static formula, efficiency of file group, group capacity of piles in cohesionless and cohesive soils, negative skin friction, pile load tests, Settlement of piles, under reamed piles (only introductory concepts – no derivation)	**10 Hours**	**L2,L3,L4**

Course outcomes: On the completion of this course students are expected to attain the following outcomes;

1. Ability to plan and execute geotechnical site investigation program for different civil engineering projects
2. Understanding of stress distribution and resulting settlement beneath the loaded footings on sand and clayey soils
3. Ability to estimate factor of safety against failure of slopes and to compute lateral pressure distribution behind earth retaining structures
4. Ability to determine bearing capacity of soil and achieve proficiency in proportioning shallow isolated and combined footings for uniform bearing pressure
5. Capable of estimating load carrying capacity of single and group of piles

Program Objectives

- Engineering knowledge
- Problem analysis
- Interpretation of data

Question paper pattern:

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.
- Use of IS: 6403 shall be permitted.

Text Books:

1. Gopal Ranjan and Rao A.S.R., Basic and Applied Soil Mechanics, New Age International (P) Ltd., New Delhi.
2. Punmia B C, Soil Mechanics and Foundation Engineering, Laxmi Publications co., New Delhi.
3. Murthy V.N.S., Principles of Soil Mechanics and Foundation Engineering, UBS Publishers and Distributors, New Delhi.
4. Braja, M. Das, Geotechnical Engineering; Thomson Business Information India (P) Ltd., India

Reference Books:

1. T.W. Lambe and R.V. Whitman, Soil Mechanics-, John Wiley & Sons
2. Donald P Coduto, Geotechnical Engineering- Phi Learning Private Limited, New Delhi
3. Shashi K. Gulathi & Manoj Datta, Geotechnical Engineering-. , Tata McGraw Hill Publications
4. Debashis Moitra, “Geotechnical Engineering” , Unive rsities Press.,
5. Malcolm D Bolton, “ A Guide to soil mechanics”, Uni versities Press.,
6. Bowles J E , Foundation analysis and design, McGraw- Hill Publications

Course Title: Computer Aided Building Planning and Drawing

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

SEMESTER: V

Subject Code	15CV54	IA Marks	20
Number of Lecture Hours/Week	04 (1hr Instructions + 3hr Drawing)	Exam Marks	80
Total Number of Lecture/Practice Hours	50	Exam Hours	03
	CREDITS – 04	**Total Marks-100**	

Course objectives: Provide students with a basic understanding

- Achieve skill sets to prepare computer aided engineering drawings
- Understand the details of construction of different building elements.
- Visualize the completed form of the building and the intricacies of construction based on the engineering drawings.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module:1		
Drawing Basics: Selection of scales for various drawings, thickness of lines, dimensioning, abbreviations and conventional representations as per IS: 962 Simple engineering drawings with CAD drawing tools : Lines, Circle, Arc, Polyline, Multiline, Polygon, Rectangle, Spline, Ellipse, Modify 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, Customising toolbars, Working with multiple drawings	**12 Hours**	**L1,L2**
Module:2		
Drawings Related to Different Building Elements: Following drawings are to be prepared for the data given using CAD Software a) Cross section of Foundation, masonry wall, RCC columns with isolated & combined footings. b) Different types of bonds in brick masonry c) Different types of staircases – Dog legged, Open we ll d) Lintel and chajja e) RCC slabs and beams f) Cross section of a pavement g) Septic Tank and sedimentation Tank	**12 Hours**	**L2,L3,L4,L5,L6**

h) Layout plan of Rainwater recharging and harvesting system i) Cross sectional details of a road for a Residential area with provision for all services j) Steel truss (connections Bolted) *Note: Students should sketch to dimension the above in a sketch book before doing the computer drawing*		
Module -3:		
Building Drawings: Principles of planning, Planning regulations and building bye-laws, factors affecting site selection, Functional planning of residential and public buildings, design aspects for different public buildings. Recommendations of NBC. Drawing of Plan, elevation and sectional elevation including electrical, plumbing and sanitary services *using CAD software* for: 1. Single and Double story residential building 2. Hostel building 3. Hospital building 4. School building 5. *Submission drawing (sanction drawing) of two storied residential building with access to terrace including all details and statements as per the local bye-laws* **Note:** • Students should sketch to dimension the above in a sketch book before doing the computer drawing • *One compulsory field visit/exercise to be carried out.* • Single line diagrams *to be given in the examination.*	**26 Hours**	**L2,L3,L4,L5,L6**
Course Outcomes: After studying this course, students will be able to 1. Gain a broad understanding of planning and designing of buildings 2. Prepare, read and interpret the drawings in a professional set up. 3. Know the procedures of submission of drawings and Develop working and submission drawings for building 4. Plan and design a residential or public building as per the given requirements		
Program Objectives • Engineering knowledge • Problem analysis • Interpretation of data		
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 two full questions from Module 3 with each full question carrying ***fifty*** marks. Students have to answer one question.		

- The conduction of examination and question paper format of should be in lines of 1st year CAED drawing. It's a drawing paper but the exam will be conducted by batches in the computer labs. question papers should be given in batches

Text book:

1. MG Shah, CM Kale, SY Patki, **"Building drawing with an integrated approach to B uilt Environment Drawing"** , Tata Mc Graw Hill Publishing co. Ltd., New Delhi
2. Gurucharan Singh, **"Building Construction",** Standard Publishers, & distributors, New Delhi.
3. Malik R S and Meo G S, **"Civil Engineering Drawing"** , Asian Publishers/Computech Publications Pvt Ltd.

Reference Books:

1. Time Saver Standard by Dodge F. W., F. W. Dodge Corp.,
2. IS: 962-1989 (Code of practice for architectural and building drawing)
3. **National Building Code**, BIS, New Delhi.

Course Title: Air Pollution and Control

Professional Elective-1

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

SEMESTER:V

Subject Code	15CV551	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

- Study the sources and effects of air pollution
- Learn the meteorological factors influencing air pollution.
- Analyze air pollutant dispersion models
- 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.	8 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	8 Hours	L1,L2,L3
Module -3		
Sampling: Sampling of particulate and gaseous pollutants (Stack, Ambient & indoor air pollution), Monitoring and analysis of air pollutants ($PM_{2.5}$, PM_{10}, SO_X, NO_X, CO, NH_3)	8 Hours	L2,L3,L4
Module -4		
Control Techniques: Particulate matter and gaseous pollutants- settling chambers, cyclone separators, scrubbers, filters & ESP.	8 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	8 Hours	L3,L4,L5,L6

Course Outcomes: After studying this course, students will be able to:

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.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

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.

Text Books:

1. M. N. Rao and H V N Rao, “Air pollution”, Tata Mc-G raw Hill Publication.
2. H. C. Perkins, “Air pollution”. Tata McGraw Hill Pu blication
3. Mackenzie Davis and David Cornwell, “Introduction t o 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 Contr ol Technologies”, Allied Publishers

Course Title: Railways, Harbour, Tunneling and Airports

Professional Elective-1

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

SEMESTER:V

Subject Code	15CV552	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. Understand the history and development, role of railways, railway planning and development based on essential criteria's.
2. Learn different types of structural components, engineering properties of the materials, to calculate the material quantities required for construction
3. Understand various aspects of geometric elements, points and crossings, significance of maintenance of tracks.
4. Design and plan airport layout, design facilities required for runway, taxiway and impart knowledge about visual aids
5. Apply design features of tunnels, harbours, dock and necessary navigational aids; also expose them to various methods of tunneling and tunnel accessories.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Railway Planning: Significance of Road, Rail, Air and Water transports – Coordination of all modes to achieve sustainability – Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and faste nings, – Track Stress, coning of wheels, creep in rails, defects in rails – Route al ignment surveys, conventional and modern methods- – Soil suitability analysis – G eometric design of railways, gradient, super elevation, widening of gauge on curves- Points and Crossings.	8 hours	L1,L2,L3
Module -2		
Railway Construction and Maintenance: Earthwork – Stabilization of track on poor soil, Calculation of Materials required for track laying – Construction and maintenance of tracks – Modern methods of construct ion & maintenance – Railway stations and yards and passenger amenities- Urban rail – Infrastructure for Metro, Mono and underground railways.	8 Hours	L2, L3
Module -3		

Harbour and Tunnel Engineering: Definition of Basic Terms: Planning and Design of Harbours: Requirements, Classification, Location and Design Principles – Harbour Layout and Terminal Facilities , Coastal Structures, Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works. Tunneling: Introduction, size and shape of the tunnel, tunneling methods in soils, tunnel lining, tunnel drainage and ventilation.	8 Hours	L1,L2,L3
Module -4		
Airport Planning: Air transport characteristics, airport classification, air port planning: objectives, components, layout characteristics, socio-economic characteristics of the catchment area, criteria for airport site selection and ICAO stipulations, typical airport layouts, Parking and circulation area.	8 Hours	L1,L2,L3
Module -5		
Airport Design : Runway Design: Orientation, Wind Rose Diagram, Runway length, Problems on basic and Actual Length, Geometric design of runways, Configuration and Pavement Design Principles, Elements of Taxiway Design, Airport Zones, Passenger Facilities and Services, Runway and Taxiway Markings and lighting.	8 Hours	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

1. Acquires capability of choosing alignment and also design geometric aspects of railway system, runway, taxiway.
2. Suggest and estimate the material quantity required for laying a railway track and also will be able to determine the hauling capacity of a locomotive.
3. Develop layout plan of airport, harbor, dock and will be able relate the gained knowledge to identify required type of visual and/or navigational aids for the same.
4. Apply the knowledge gained to conduct surveying, understand the tunneling activities.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

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.

Text Books:

1. Saxena Subhash C and Satyapal Arora, “A Course in R ailway Engineering”, Dhanpat Rai and Sons, Delhi,
2. Satish Chandra and Agarwal M.M, “Railway Engineerin g”, 2nd Edition, Oxford University Press, New Delhi ,
3. Khanna S K, Arora M G and Jain S S, “Airport Planni ng and Design”, Nemchand and Brothers, Roorkee,
4. C Venkatramaiah, “ Transportation Engineering”, Vol ume II: Railways, Airports, Docks and Harbours, Bridges and

Tunnels, Universities Press

5. Bindra S P, "A Course in Docks and Harbour Engineer ing", Dhanpat Rai and Sons, New Delhi,

Reference Books:

1. Oza.H.P. and Oza.G.H., "A course in Docks & Harbour Engineering". Charotar Publishing Co.,
2. Mundrey J.S. "A course in Railway Track Engineering ". Tata McGraw Hill,
3. Srinivasan R. Harbour, "Dock and Tunnel Engineering ", 26th Edition 2013

Course Title: Masonry Structures

Professional Elective-1

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

SEMESTER:V

Subject Code	15CV553	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. Understand properties of masonry units, strength and factors affecting strength.
2. Understand design criteria of various types of wall subjected to different load system.
3. Impart the culture of following the codes for strength, serviceability and durability as an ethics.
4. Provide knowledge in analysis and design of masonry elements for the success in competitive examinations.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Masonry Units, Materials, types and masonry construction: Bricks, Stone and Block masonry units- strength, modulus of elasticity and water absorption of masonry materials – classification and properties o f mortars. Defects and Errors in masonry construction – cracks in masonry, types, reason for cracking, methods of avoiding cracks. **Strength and Stability:** Strength and stability of axially loaded masonry walls, effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of curing, effect of ageing, workmanship. Compressive strength formulae based on elastic theory and empirical formulae.	8 hours	L1,L2,L3
Module -2		
Permissible stresses: Types of walls, permissible compressive stress, stress reduction and shape modification factors, increase in permissible stresses for eccentric vertical and lateral load, permissible tensile stress and shear stresses. **Design Considerations:** Effective height of walls and columns, openings in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action in lintels. Problems on design considerations for solid walls, cavity walls, wall with pillars.	8 Hours	L1,L2,L3

Module -3		
Load considerations and design of Masonry subjected to axial loads: Design criteria, design examples of walls under UDL, solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers.	8 Hours	L1,L2,L3
Module -4		
Design of walls subjected to concentrated axial loads: Solid walls, cavity walls, solid wall supported at the ends by cross wall, walls with piers, design of wall with openings. **Design of walls subjected to eccentric loads**: Design criteria – stress distribution under eccentric loads – problems on eccentrically l oaded solid walls, cavity walls, walls with piers.	8 Hours	L2,L3,L4,L5
Module -5		
Design of Laterally and transversely loaded walls: Design criteria, design of solid wall under wind loading, design of shear wall – design of compound walls. Introduction to reinforced brick masonry, lintels and slabs. **In-filled frames**: Types – modes of failures – design criteria of ma sonry retaining walls.	8 Hours	L2,L3,L4,L5

Course Outcomes: After studying this course, students will be able to:

1. Explain engineering properties and uses of masonry units, defects and crack in masonry and its remedial measures.
2. Summarize various formulae's for finding compressive strength of masonry units.
3. Explain permissible stresses and design criteria as per IS: 1905 and SP-20.
4. Design different types of masonry walls for different load considerations.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

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.
- Use of **IS 1905–1987** "Code of practice for structural use of un-reinfor ced masonry" may be permitted.

Text Books:

1. Henry, A.W., " **Structural Masonry"** , Macmillan Education Ltd., 1990.

2. Dayaratnam P, **"Brick and Reinforced Brick Structures",** Oxford & IBH, 1987.

3. M. L. Gambhir, " **Building and Construction Materials",** Mc Graw Hill education Pvt. Ltd.

Reference Books:

1. IS 1905–1987 "Code of practice for structural use o f un-reinforced masonry- (3rd revision) BIS, New Delhi.
2. SP 20 (S&T) – 1991, "Hand book on masonry design an d construction (1^{st} revision) BIS, New Delhi.

Course Title: Theory of Elasticity

Professional Elective-1

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

SEMESTER:V

Subject Code	15CV554	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. This course advances students from the one-dimensional and linear problems conventionally treated in courses of strength of materials into more general, two and three-dimensional problems.
2. The student will be introduced to rectangular and polar coordinate systems to describe stress and strain of a continuous body.
3. Introduction to the stress – strain relationship, b asic principles and mathematical expressions involved in continuum mechanics. also solution of problems in 2- dimensional linear elasticity

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Concepts of continuum, Stress at a point, Components of stress, Differential equations of equilibrium, Stress transformation, Principal stresses, Maximum shear stress, Stress invariants. Strain at a point, Infinitesimal strain, Strain-displacement relations, Components of strain, Compatibility Equations, Strain transformation, Principal strains, Strain invariants, Measurement of surface strains, strain rosettes	08 hours	L1, L2, L3
Module -2		
Generalized Hooke's Law, Stress-strain relationships, Equilibrium equations in terms of displacements and Compatibility equations in terms of stresses, Plane stress and plane strain problems, St. Venant's principle, Principle of superposition, Uniqueness theorem, Airy's stress function, Stress polynomials (Two Dimensional cases only)**.**	08 Hours	L1, L2, L3
Module -3		
Two-dimensional problems in rectangular coordinates, bending of a cantilever beam subjected to concentrated load at free end, effect of shear deformation in beams, Simply supported beam subjected to Uniformly distributed load. Two-dimensional problems in polar coordinates, strain-displacement relations,	08 Hours	L3, L4

equations of equilibrium, compatibility equation, stress function.		
Module -4		
Axisymmetric stress distribution - Rotating discs, Lame's equation for thick cylinder, Effect of circular hole on stress distribution in plates subjected to tension, compression and shear, stress concentration factor.	08 Hours	L3, L4
Module -5		
Torsion: Inverse and Semi-inverse methods, stress function, torsion of circular, elliptical, triangular sections	08 Hours	L3, L4

Course outcomes: On the completion of this course students are expected to attain the following outcomes;

1. Ability to apply knowledge of mechanics and mathematics to model elastic bodies as continuum
2. Ability to formulate boundary value problems; and calculate stresses and strains
3. Ability to comprehend constitutive relations for elastic solids and compatibility constraints;
4. Ability to solve two-dimensional problems (plane stress and plane strain) using the concept of stress function.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

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.

Text Books:

1. S P Timoshenko and J N Goodier, "Theory of Elastici ty", McGraw-Hill International Edition, 1970.
2. Sadhu Singh, "Theory of Elasticity", Khanna Publish ers, 2012
3. S Valliappan, "Continuum Mechanics - Fundamentals", Oxford & IBH Pub. Co. Ltd., 1981.
4. L S Srinath, "Advanced Mechanics of Solids", Tata - McGraw-Hill Pub., New Delhi, 2003

Reference Books:

1. C. T. Wang, "Applied Elasticity", Mc-Graw Hill Book Company, New York, 1953
2. G. W. Housner and T. Vreeland, Jr., "The Analysis o f Stress and Deformation", California Institute of Tech., CA, 2012. [Download as per user policy from http://resolver.caltech.edu/CaltechBOOK:1965.001]
3. A. C. Ugural and Saul K. Fenster, "Advanced Strengt h and Applied Elasticity", Prentice Hall, 2003.
4. Abdel-Rahman Ragab and Salah Eldinin Bayoumi, "Engi neering Solid Mechanics: Fundamentals and

Applications", CRC Press, 1998

Course Title: Traffic Engineering

Open Elective-1

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

SEMESTER:V

Subject Code	15CV561	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. Understand fundamental knowledge of traffic engineering, scope and its importance.
2. describe basic techniques for collecting and analysing traffic data, diagnosing problems, designing appropriate remedial treatment, and assessing its effectiveness.
3. Apply probabilistic and queuing theory techniques for the analysis of traffic flow situations and emphasis the interaction of flow efficiency and traffic safety.

4. understand and analyse traffic issues including safety, planning, design, operation and control. 5.

Apply intelligent transport system and its applications in the present traffic scenario.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Traffic Planning and Characteristics: Road Characteristics-Road user characteristics, PIEV theory, Vehicle Performance characteristics, Fundamentals of Traffic Flow, Urban Traffic problems in India, Integrated planning of town, country, regional and all urban infrastructures, Sustainable approach- land use & transport and modal integration.	8 hours	L1,L2,L3
Module -2		
Traffic Surveys: Traffic Surveys- Speed, journey time and delay surveys, Vehicles Volume Survey including non-motorized transports, Methods and interpretation, Origin Destination Survey, Methods and presentation, Parking Survey, Accident analyses-Methods, interpretation and presentation, Statistical applications in traffic studies and traffic forecasting, Level of service- Concept,	8 Hours	L1,L2,L3,L4,L5

applications and significance.		
Module -3		
Traffic Design and Visual Aids: Intersection Design- channelization, Rotary intersection design, Signal design, Coordination of signals, Grade separation, Traffic signs including VMS and road markings, Significant roles of traffic control personnel, Networking pedestrian facilities & cycle tracks.	8 Hours	L1,L2,L3,L4
Module -4		
Traffic Safety and Environment: Road accidents, Causes, effect, prevention, and cost, Street lighting, Traffic and environment hazards, Air and Noise Pollution, causes, abatement measures, Promotion and integration of public transportation, Promotion of non-motorized transport.	8 Hours	L1,L2,L3
Module -5		
Traffic Management: Area Traffic Management System, Traffic System Management (TSM) with IRC standards, Traffic Regulatory Measures, Travel Demand Management (TDM), Direct and indirect methods, Congestion and parking pricing, All segregation methods- Coordination among different agencies, Intelligent Transport System for traffic management, enforcement and education.	8 Hours	L1,L2,L3,L4

Course outcomes: After studying this course, students will be able to:

1. Understand the human factors and vehicular factors in traffic engineering design.
2. Conduct different types of traffic surveys and analysis of collected data using statistical concepts.
3. Use an appropriate traffic flow theory and to comprehend the capacity & signalized intersection analysis.
4. Understand the basic knowledge of Intelligent Transportation System.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

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.

Text Books:

1. Kadiyali.L.R. **"Traffic Engineering and Transport Planning** ", Khanna Publishers, Delhi, 2013
2. S K Khanna and CEG Justo and A Veeraragavan, **"Highway Engineering** ", Nem Chand and Bros.
3. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and

Management.

4. Salter. R.I and Hounsell N.B, " **Highway Traffic Analysis and design**", Macmillan Press Ltd.1996.

Reference Books:

1. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi, 2011
2. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010
3. SP:43-1994, IRC Specification, "Guidelines on Low-c ost Traffic Management Techniques" for Urban Areas, 1994
4. John E Tyworth, "Traffic Management Planning, Opera tions and control", Addison Wesly Publishing Compan y, 1996
5. Hobbs.F.D. "Traffic Planning and Engineering", Univ ersity of Brimingham, Peragamon Press Ltd, 2005

Course Title: Sustainability Concepts in Engineering

Open Elective 1

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

SEMESTER:V

Subject Code	15CV562	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. Learn about the principles, indicators and general concept of sustainability.
2. Apprehend the local, regional and global impacts of unsustainable designs, products and processes.
3. Student shall be able to apply the sustainability concepts in engineering
4. Know built environment frameworks and their use
5. Understand how building and design is judged and valued by clients and stakeholders and how to implement sustainability.

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Introduction: Sustainability - Introduction, Need and concept of sustainability, Social-environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM), Environmental legislations in India - Water Act, Air Act.	8 hours	L1,L2,L3
Module -2		
Global Environmental Issue: Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print Carbon sequestration – Carbon capture and sto rage (CCS). Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and	8 Hours	L1,L2,L3

Goal, Bio-mimicking		
Module -3		
Sustainable Design: Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification- GRIHA & IGBC Certification for buildings, Energy efficient building design- Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable transport.	8 Hours	L1,L2,L3,L4
Module -4		
Clean Technology and Energy: Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy. Rainwater harvesting	8 Hours	L1,L2,L3
Module -5		
Green Engineering: Green Engineering concepts, Sustainable Urbanization, industrialization and poverty reduction; Social and technological change, Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.	8 Hours	L1,L2,L3

Course Outcomes: After studying this course, students will be able to:

1. Learn the sustainability concepts, understand the role and responsibility of engineers in sustainable development
2. Quantify sustainability, and resource availability, Rationalize the sustainability based on scientific merits
3. Understand and apply sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines
4. Make a decision in applying green engineering concepts and become a lifelong advocate of sustainability in society

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

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.

Text Books:

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning

Reference Books:

1. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication
2. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
3. Ni bin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
4. Twidell, J. W. and Weir, A. D., Renewable Energy Resources, English Language Book Society (ELBS).
5. Malcolm Dowden, Climate Change and Sustainable Development: Law, Policy and Practice
6. Daniel A. Vallero and Chris Brasier, " Sustainable Design: The Science of Sustainability and Green Engineering", Wiley-Blackwell
7. Sustainable Engineering Practice: An Introduction, Committee on Sustainability, American Society of Civil Engineers

Course Title: Remote Sensing and GIS

Open Elective 1

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

SEMESTER:V

Subject Code	15CV563	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. 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, and vegetation), Resolution, image registration and Image and False color composite, elements of visual interpretation techniques.	8 hours	L1, L2,L3
Module -2		
Remote Sensing Platforms and Sensors: Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms- IRS, Landsat, SPOT, Cartosat, Ikonos, Envisat etc. sensors, sensor resolutions (spatial, spectral, radiometric and	8 Hours	L2,L3,L4

temporal). Basics of digital image processing- introduction to digital data, systematic errors(Scan Skew, Mirror-Scan Velocity, Panoramic Distortion, Platform Velocity , Earth Rotation) and non-systematic [random] errors(Altitude, Attitude), Image enhancements(Gray Level Thresholding, level slicing, contrast stretching),image filtering.		
Module -3		
Geographic Information System: Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute data-Joining Spatial and attribute data, GIS Operations: Spatial Data Input – Attribute data Management, Geographic coordinate System, Datum; Map Projections: Types of Map Projections, Projected coordinate Systems. UTM Zones.	8 Hours	L2,L3,L4
Module -4		
Data Models: Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Relational Database, Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data conversion.	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. Location Based Services And Its Applications.	8 Hours	L3,L4,L5,L6

Course outcomes: After studying this course, students 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:

- Engineering knowledge
- Problem analysis
- Interpretation of data

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.

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 Ima ge Interpretation", Wiley 2011.

Reference Books:

1. Chor Pang Lo and Albert K.W Yeung, "Concepts & Tech niques of GIS", PHI, 2006
2. John R. Jensen, "Remote sensing of the environment" , An earth resources perspective – 2nd edition – by Pearson Education 2007.

- Anji Reddy M., "Remote sensing and Geograperhical i nformation system", B.S. Publications 2008.
- Peter A. Burrough, Rachael A. McDonnell, and Christopher D. Lloyd, "Principals of Geo physical Informa tion system", Oxford Publications 2004.
- S Kumar, "Basics of remote sensing & GIS", Laxmi pu blications 2005.

Course Title: Occupational Health and Safety

Open Elective 1

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

SEMESTER:V

Subject Code	15CV564	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 an historical, economic, and organizational perspective of occupational safety and health;
2. Investigate current occupational safety and health problems and solutions.
3. Identify the forces that influence occupational safety and health.
4. Demonstrate the knowledge and skills needed to identify workplace problems and safe work practice

Modules	**Teaching Hours**	**Revised Bloom's Taxonomy (RBT) Level**
Module -1		
Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know. **Accident –** causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation	8 hours	L1,L2,L3
Module -2		
Ergonomics at Work Place: Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space Envelops, Visual Ergonomics, Ergonomic Standards, Ergonomic Programs. **Hazard cognition and Analysis,** Human Error Analysis – Fault Tree Analysis – Emergency Response - Decision for action – purpose and	8 Hours	L2,L3,L4,L5

considerations		
Module -3		
Fire Prevention and Protection: Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers. **Electrical Safety, Product Safety:** Technical Requirements of Product safety.	8 Hours	L2,L3,L4,L5
Module -4		
Health Considerations at Work Place: types of diseases and their spread, Health Emergency. **Personal Protective Equipment (PPE)** – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability	8 Hours	L2,L3,L4,L5
Module -5		
Occupational Health and Safety Considerations: Water and wastewater treatment plants, Handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC Plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors	8 Hours	L3,L4,L5.L6

Course Outcomes: After studying this course, students will be able to:

1. Identify hazards in the workplace that pose a danger or threat to their safety or health, or that of others.
2. Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
3. Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the occupational Health and Safety Regulations as well as supported legislation.
4. Discuss the role of health and safety in the workplace pertaining to the responsibilities of workers, managers, supervisors.
5. Identify the decisions required to maintain protection of the environment, workplace as well as personal health and safety.

Program Objectives:

- Engineering knowledge
- Problem analysis
- Interpretation of data

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.

Text Books:

1. Goetsch D.L., (1999), "Occupational Safety and Heal th for Technologists, Engineers and Managers", Pren tice Hall.

2. Heinrich H.W., (2007), "Industrial Accident Prevent ion - A Scientific Approach", McGraw-Hill Book Comp any

3. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "Industrial Safety and Poll ution Control Handbook

Reference Books:

1. Colling D.A., (1990), "Industrial Safety Management and Technology", Prentice Hall, New Delhi.

2. Della D.E., and Giustina, (1996), "Safety and Envir onmental Management", Van Nostrand Reinhold Interna tional Thomson Publishing Inc.

Course Title: Geotechnical Engineering Lab

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

SEMESTER: V

Subject Code	15CVL57	IA 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

- To carry out laboratory tests and to identify soil as per IS codal procedures
- To perform laboratory tests to determine index properties of soil
- To perform tests to determine shear strength and consolidation characteristics of soils

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
1. Visual soil classification. Water content determination by oven drying method and infrared moisture method. Specific gravity test (pycnometer and density bottle method).	**6 Hours**	**L1, L2**
2. Grain size analysis i. Sieve analysis ii. Hydrometer analysis	**3 Hours**	**L1, L2**
3. In-situ density tests i. Core-cutter method ii. Sand replacement method	**3 Hours**	**L1, L2**

4. Consistency limits i. Liquid limit test (by Casagrande's and cone penetration method) ii. Plastic limit test iii. Shrinkage limit test	**3 Hours**	**L1, L2**
5. Standard compaction test (light and heavy compaction)	**3 Hours**	**L1, L2**
6. Co-efficient of permeability test i. Constant head test ii. Variable head test	**3 Hours**	**L1, L2**
7. Shear strength tests i. Unconfined compression test ii. Direct shear test iii. Triaxial test (undrained unconsolidated)	**9 Hours**	**L1, L2**
8. Consolidation test : Determination of compression index and co-efficient of consolidation	**3 Hours**	**L1, L2**
9. Laboratory vane shear test	**3 Hours**	**L1, L2**
10. Demonstration of Swell pressure test, Standard penetration test and boring equipment	**6 Hours**	**L1, L2**

Course Outcomes: Students will be able to conduct appropriate laboratory/field experiments and interpret the results to determine

1. Physical and index properties of the soil
2. Classify based on index properties and field identification
3. To determine OMC and MDD, plan and assess field compaction program
4. Shear strength and consolidation parameters to assess strength and deformation characteristics
5. In-situ shear strength characteristics (SPT- Demonstration)

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 Eas tern Ltd., New Delhi.
3. Head K.H., “Manual of Soil Laboratory Testing” Vol. I, II, III, Princeton Press
4. Bowles J.E., “Engineering Properties of Soil and Th eir 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 - 1 0) – 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) – 1 966, IS 2720 (Part-60) 1965.

Course Title: Concrete and Highway Materials Laboratory

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

SEMESTER: V

Subject Code	15CVL58	IA 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:

- To learn the principles and procedures of testing Concrete and Highway materials and to get hands on experience by conducting the tests and evolving inferences.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Part A: Concrete Lab		
1. Tests on Cement: a. Normal Consistency b. setting time c. compressive strength d. fineness by air permeability test e. specific gravity	**6 Hours**	**L1, L2**
2. Tests on Concrete: a. Design of concrete mix as per IS-10262 b. Tests on fresh concrete: i. slump, ii. compaction factor and iii. Vee Bee test c. Tests on hardened concrete:	**9 Hours**	L2,L3

i. compressive strength test, ii. split tensile strength test, iii. flexural strength test d. NDT tests by rebound hammer and pulse velocity test.		
3. Tests on Self Compacting Concrete: a. Design of self compacting concrete, b. slump flow test, c. V-funnel test, d. J-Ring test, e. U Box test and f. L Box test	**3 Hours**	L2,L3
Part B: High way materials Lab		
1. Tests on Aggregates a. Aggregate Crushing value b. Los Angeles abrasion test c. Aggregate impact test d. Aggregate shape tests (combined index and angularity number)	**3 Hours**	**L1, L2**
2. Tests on Bituminous Materials a. Penetration test b. Ductility test c. Softening point test d. Specific gravity test e. Viscosity test by tar viscometer f. Bituminous Mix Design by Marshall Method (Demonstration only)	**9 Hours**	**L1, L2,L3**
3. Tests on Soil a. Wet sieve analysis b. CBR test	**6 Hours**	**L1, L2**

Course outcomes: After studying this course, students will be able to:

1. Conduct appropriate laboratory experiments and interpret the results
2. Determine the quality and suitability of cement
3. Design appropriate concrete mix
4. Determine strength and quality of concrete
5. Test the road aggregates and bitumen for their suitability as road material.
6. Test the soil for its suitability as sub grade soil for pavements.

Reference Books:

1. M.L.Gambir, **"Concrete Manual",** Danpat Rai and sons, New Delhi
2. Shetty M.S, **"Concrete Technology"** , S. Chand & Co. Ltd, New Delhi.
3. Mehta P.K, **"Properties of Concrete",** Tata McGraw Hill Publications, New Delhi.
4. Neville AM, **"Properties of Concrete",** ELBS Publications, London.
5. Relevant BIS codes.
6. S K Khanna, C E G Justo and A Veeraragavan, **"Highway Materials Testing Laboratory Manual** ", Nem Chand Bros, Roorkee
7. L R Kadiyali, **"Highway Engineering** ", Khanna Publishers, New Delhi

8. Relevant IRC Codes
9. Specifications for Roads and Bridges-MoRT&H, IRC, New Delhi