Course Code	BCIVCIS525					
Category	Programme Core Course					
Course Title	Analysis of Indeterminate Structures					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 5 (Five)
	2	1	2	5	4	
Pre requisites	**Physics, Mathematics, Strength of Materials. Structural analysis.**					

Course Learning Outcomes (CLOs)

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

***i)* CLO1:** Identify, understand and determine the degree of kinematic and static degree of indeterminacy of various types of structures.

***ii)* CLO2:** Analysis of the deflections, bending moments and shear force through energy methods in determinate and indeterminate structures.

***iii)* CLO3::** Understand the basic concepts of force and displacement methods.

***iv)* CLO4::** Analysis of structures through force and displacement methods.

***v)* CLO5:** Analysis of determinate and indeterminate beams, plane frames and space frames.

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Force methods: Analysis of Propped cantilevers, Continuous and Fixed Beams, frames and trusses using energy methods; Betti-Maxwell's Reciprocal theorem, Castigliano's 1st and 2nd theorem of minimum energy, and Method of consistent deformation. Clapeyron's Three Moment equation for fixed and continuous beams.
Module 2.	Displacement methods: Slope and deflection method: Analysis of indeterminate Beams (with and without yielding supports) and Frames (with and without Sway).
Module 3.	Distribution factors, analysis of indeterminate Beams (with and without yielding supports) and Frames (with and without sway) by moment distribution method.
Module 4.	Influence Line Diagrams (ILDs): Analysis of statically indeterminate beams using Muller-Breslau's principle. Arches: Normal thrust, shear force, and bending moment for two and three hinged arches. Influence lines for normal thrust, shear force and bending moment for three hinged parabolic arches.
Module 5.	Plastic analysis of beams and rectangular portal frames using plastic modulus, load factor, and relevant theorems.

CLO-PLO Mapping Matrix													
CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	3	3	3	0	1	1	1	0	0	0	1	1.17
CLO2	3	3	3	3	0	1	1	1	0	0	0	0	1.17
CLO3	3	3	3	3	0	1	1	1	0	0	0	0	1.17
CLO4	3	3	3	3	0	1	1	1	0	0	0	0	1.17
CLO5	3	3	3	3	0	1	1	1	0	0	0	0	1.17
Avg PLO	3	3	2.2	2.8	0	1	1	1	0	0	0	0	1.17

S.No:	Text Books	Author	Publisher
1.	Structural analysis.	R. C. Hibbeler.	Pearson Prentice Hall
2	Indeterminate Structural Analysis	C. K. Wang	Tata McGraw Hill
	References		
1.	Theory of Structures.	S. Timoshenko and Young	Tata McGraw Hill
2.	Structural Analysis.	L.S. Negi and R.S. Jangid	Tata McGraw Hill
3.	Elementary Theory of Structures.	Yuan Yu Hsieh	Prentice Hall
4.	Fundamentals of Structural Analysis.	Kenneth Leet	Tata McGraw Hill

List Of Experiments	
S.No.	Name Of Experiments
1.	Deflection of curved beams.
2.	Behavior of portal frame under different load combinations.
3.	Deflection of Truss.
4.	Behavior of a cantilever beam under symmetrical and unsymmetrical loading.
5.	Analysis of a redundant joint.
6.	Verification of Maxwell's Theorem— To verify the principle of Maxwell's theorem.
7.	Analysis of two hinged arches.
8.	Verification of Horizontal Thrust in a 3-Hinged Arch To evaluate experimentally horizontal thrust in a 3-hinged arch and draw an influence line diagram for the horizontal thrust.

Course Code	**BCIVCSM525**					
Category	**Programme Core Course**					
Course Title	**Soil Mechanics**					
Scheme and Credits	**L**	**T**	**P**	**No. of Hrs./Week**	**Credits**	**Semester- 5 (Five)**
	2	**1**	**2**	**5**	**4**	
Prerequisites	**Physics, Strength of Materials**					

Course Learning Outcomes (CLOs)

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

i) CLO1: Classify soils and understand their origin, phase relationships, and fundamental engineering properties.

ii) CLO2: Analyse the significance of soil permeability (k) and its role in soil behaviour.

iii) CLO3: Solve and interpret problems related to consolidation settlement and field compaction.

iv) CLO4: Compute stress distribution in soil masses and analyse effective stress principles.

v) CLO5: Apply appropriate field and laboratory soil investigation methods.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Historical development of soil engineering; Origin and general types of soils; Three-phase system; Index properties; Identification and Classification of soils; Clay mineralogy.
Module 2.	Flow through soils; Darcy's Law; Permeability factors and determination in lab and field; Permeability factor for stratified soil; Seepage force; Laplace equation for steady-state flow; Flow net for homogeneous embankments.
Module 3.	Compaction; Laboratory compaction tests; Compaction curve; Control on field compaction; One-dimensional consolidation; Terzaghi's equation; Consolidation test; e-log p curves; Consolidation settlement; Time required for settlement.
Module 4.	Total and effective stresses; Pore water pressure; Stress distribution under concentrated load; Influence factors; Isobars; Boussinesq's equation, Westergaard's Method and Newmark's Influence Chart; Contact pressure under rigid and flexible area; computation of displacements from elastic theory.
Module 5.	Sub-soil exploration; Planning; Auger boring; Sampling; Penetration methods; Geophysical methods – electrical resistivity and seismic method; Suitability of tests.

CLO-PLO Mapping Matrix													
CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	3	2	3	1	2	1	0	2	0	0	3	**1.67**
CLO2	3	3	3	2	1	2	1	0	2	0	0	3	**1.67**
CLO3	3	3	3	2	2	2	1	0	2	1	1	3	**1.92**
CLO4	3	3	3	2	2	1	1	0	1	1	0	3	**1.75**
CLO5	3	3	3	3	3	1	1	0	2	2	0	3	**2**
Avg PLO	**3**	**3**	**2.8**	**2.4**	**1.8**	**1.6**	**1**	**0**	**1.8**	**0.8**	**0.2**	**3**	**1.80**

S.No:	Text Books	Author	Publisher
1.	Geotechnical Engineering	Gulhati, S.K. and Datta Manoj	Tata McGraw Hill
References			
1.	Fundamentals of Geotechnical Engineering	Braja M. Das and Nagaratnam Sivakugan	Cengage Learning
2.	Principles of Geotechnical Engineering	Braja M. Das and Khaled Sobhan	Cengage Learning
3.	Soil Mechanics & Foundation Engineering	K.R.Arora	Standard Publisher Distribution
4.	Principles of Foundation Engineering	Braja M. Das	Cengage Learning

LIST OF EXPERIMENTS	
Experiment No.	Experiment Name
1.	Soil Identification Test
2.	Water Content Determination Test
3.	Field Density Measurement Test
4.	Specific Gravity Test
5.	Sieve Analysis Test
6.	Sedimentation Analysis Test
7.	Atterberg Limits Test
8.	IS Light Compaction Test
9.	Constant Head Permeability Test
10.	Falling Head Permeability Test

Course Code	BCIVLWS525					
Category	Lab Course					
Course Title	Water Supply and Sanitation Engineering					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 5 (Five)
	0	1	4	5	3	
Pre requisites	Engineering Chemistry,Fluid Mechanics					

Course Learning Outcomes (CLOs)

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

i) CLO1: Explain the principles of water supply engineering, water demand estimation, population forecasting, and the selection of suitable water sources

ii) CLO2:. Analyze water quality using physical, chemical, and biological parameters

iii) CLO3: Design the major components of water treatment plant

iv) CLO4: Describe different types of water supply systems and illustrate preliminary treatment processes and layout of water treatment plants.

v) CLO5: Apply the principles of plumbing, sanitary fixtures, and building water supply systems to ensure safe water distribution and sanitation

Theory Module (Internal Evaluation)

M.No:	Topic
Module 1.	Water supply engineering and its importance, Sources of water, Criteria for selection of a water source, Water demands, Types of water demand, Variation in demand and supply, Population forecasts.
Module 2.	Intake Structures, Factors governing location of intakes, Types of intakes, Types of conduits for conveyance, Pipe materials and joints, Types of pumps, Power and efficiency of pumps, Location of pumping station, Typical layout of pumping station.
Module 3.	Water Quality, Drinking Water Standards (IS 10500), Types of Impurities, Analysis of Water: Physical : colour, taste and odour, turbidity, Chemical: total solids, pH, hardness, chloride content, nitrogen content, alkalinity, Biological: E-coli. Waterborne diseases and their control
Module 4.	Water treatment, Methods of treatment, Screening, Sedimentation (Type 1), Coagulation and Flocculation, Filtration (rapid and slow sand), Disinfection (Chlorination), Water Softening.
Module 5.	Water distribution systems, classification, systems of supply, service reservoirs and its types, layout of distribution system, appurtenances in distribution system, leakage prevention. Water supply in buildings, plumbing and fixtures, sanitation of buildings

Activity Module	
1	**Field Visit to a Water Supply Scheme** – Visit the water source, intake, pumping station, treatment plant, service reservoir, and distribution network of a municipal water supply system. Prepare a technical report.
2	**Household Water Demand Survey** – Conduct a survey of 25–50 households to estimate per capita water consumption, peak demand, and daily water usage patterns. Compare results with CPHEEO recommendations.
3	**Water Source Assessment** – Identify nearby surface and groundwater sources and evaluate them based on quantity, quality, reliability, and suitability for potable water supply.

4	**Drinking Water Quality Analysis** – Collect water samples from different sources (tap, borewell, river, spring, etc.) and determine pH, turbidity, TDS, hardness, alkalinity, chlorides, and residual chlorine in the laboratory. Compare results with IS 10500 standards.
5	**Study of Pumps and Pumping Stations** – Visit a pumping station to identify different pumps, valves, motors, and accessories. Record pump specifications and estimate pump efficiency from field observations.
6	**Visit to a Water Treatment Plant** – Observe unit operations including screening, sedimentation, coagulation-flocculation, filtration, chlorination, and sludge handling. Prepare a process flow diagram with observations.
7	**Design of a Small Water Distribution Network** – Using suitable software, design a simple water distribution network for a residential colony, including reservoirs, pipelines, and junctions.
8	**Leakage Detection and Water Audit** – Conduct a campus or locality survey to identify visible leakages, estimate water losses, and recommend measures for reducing non-revenue water.
9	**Sanitation and Plumbing Audit of a Building** – Study the plumbing fixtures, water supply lines, drainage system, overhead storage, and sanitation facilities of an institutional or residential building. Suggest improvements based on relevant standards.
10	**Community Awareness Programme on Safe Water and Hygiene** – Organize an awareness campaign in a nearby village or school covering safe drinking water, waterborne diseases, household disinfection methods, sanitation, and water conservation.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg. CLO
CLO1	3	2	0	0	0	0	2	0	0	0	0	0	0.58
CLO2	3	3	0	3	3	0	3	0	0	0	0	0	1.25
CLO3	3	3	3	2	2	0	3	0	0	0	0	0	1.33
CLO4	3	2	2	2	2	0	2	0	0	0	0	0	1.08
CLO5	2	2	3	2	2	0	3	0	0	0	0	0	1.17
Avg. PLO	2.80	2.40	1.60	1.80	1.80	0.00	2.60	0.00	0.00	0.00	0.00	0.00	1.08

S.No:	Text Books	Author	Publisher
1	Water Supply Engineering	P.N. Modi	Standard Book House
	References		
1.	Water Supply Engineering	S.K. Garg	Khanna Publishers

2.	Water Treatment: Principles and Design	John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe , George Tchobanoglous.	John Wiley & Sons
3	Water and Wastewater Technology	Mark J. Hammer Sr. Mark J. Hammer Jr.	Pearson Education Limited

Course Code	BCIVCRE525					
Category	Programme Core Course					
Course Title	Railway Engineering					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 5 (Five)
	3	0	0	3	3	
Pre requisites	Building Materials, Highway Engineering					

Course Learning Outcomes (CLOs)

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

i) CLO1: Identify various components of Permanent way and know the construction process of railway track.

ii) CLO2: Design railway alignments and track geometry.

iii) CLO3: Plan stations, yards, points and crossings.

iv) CLO4: Apply signaling and interlocking principles.

v) CLO5: Understand maintenance practices and modern railway systems.

Theory Module (Internal and External Evaluation)

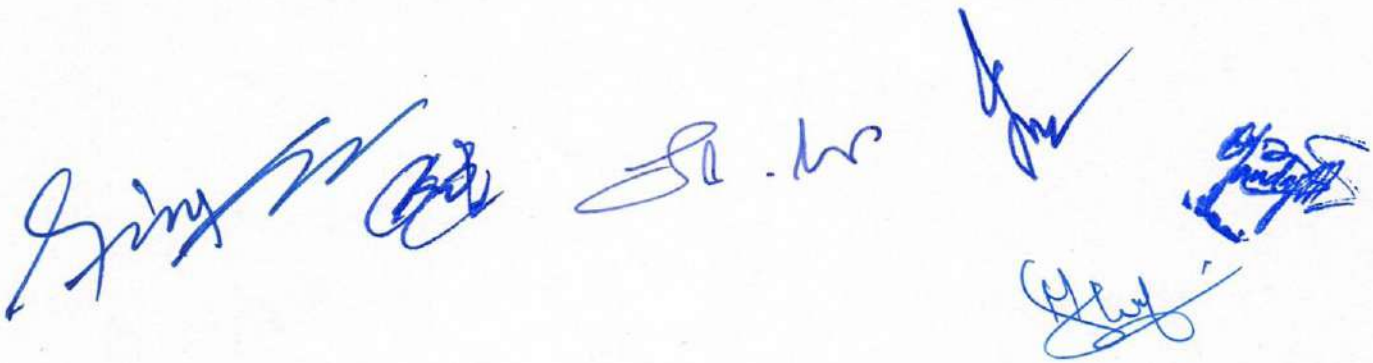
M.No:	Topic
Module 1.	Historical development of Indian Railways; Railway track alignment- basic requirements, engineering surveys for track alignment; Permanent way- typical cross-section, requirements, concept of gauges, coning of wheels; Rails- functions, requirements, types of rail sections, creep and tilt in rails; Sleepers- functions, requirements, types, sleeper density; Ballast- functions, materials, ballast less tracks; Formation- types and functions; Track fittings and fastenings.
Module 2.	Gradients, grade compensation, speed of train; superelevation, cant deficiency, superelevation distribution (near branching of curves); horizontal/vertical curves- necessity; transition curves, design of transition curves; widening of gauges on curves; Track resistance and tractive effort.
Module 3.	Points and crossings- design of turnouts; working principles; Passenger and goods stations: Types of yards: Passenger yards, Goods yards, Marshalling yards, Locomotive yard; Station equipment and layouts; Junctions and terminals.
Module 4.	Objectives of Railway Signalling; Types of Signals and signal aspects; Block systems; Centralized Traffic Control; Interlocking Principles and Methods; Route Relay Interlocking; Modern Train Control and Communication Systems; Railway Safety Measures.
Module 5.	Inspection and maintenance of track, Track drainage; Track renewal and rehabilitation; Modern track maintenance methods; High-speed rail systems; Metro and urban rail transit systems; Railway Safety and accident prevention.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg. PLO
CLO1	3	2	1	1	1	0	1	2	2	0	0	1	1.16
CLO2	3	3	3	2	2	1	2	0	0	0	1	1	1.5
CLO3	3	3	3	2	2	2	1	0	1	1	2	1	1.75
CLO4	2	3	2	2	3	3	1	2	1	1	1	1	1.83
CLO5	2	2	2	3	3	2	3	2	1	1	2	3	2.16

Avg. CLO	**2.6**	**2.6**	**2.2**	**2**	**2.2**	**1.6**	**1.6**	**1.2**	**1**	**0.6**	**1.2**	**1.4**	**1.68**

S.No:	Text Books	Author	Publisher
1.	Principles of Railway Engineering	Rangawala, S.C, (2015)	Charotar Publishers, Anand
2	A textbook of Railway Engineering	Arora, S.P. and Saxena, 2010	Dhanpat Rai & Sons
	References		
1.	Railway Engineering	Satish Chandra, M. M. Agarwal, (2013)	Oxford University Press
2.	Railway Transportation- Engineering, Operation and Management	Ponnuswamy, S, (2016)	Narosa Publishing House, New Delhi
3.	Railway Track Engineering	Mundrey, J.S. (2015)	McGraw Hill Education



Course Code	BCIVCFF525					
Category	Programme Core Course					
Course Title	Fluid Flow in Pipes & Channels					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 5 (Five)
	3	1	2	6	5	
Pre requisites	Fluid Mechanics					

Course Learning Outcomes (CLOs)

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

i) CLO1: Analyze and perform calculations on pipe flow problems involving turbulent flow, understand the concept of friction factor, head loss, and design

ii) CLO2: Apply the principles of boundary layer theory to evaluate laminar and turbulent boundary layer characteristics and their engineering significance.

iii) CLO3: Apply the principles of fluid mechanics to determine the drag and lift forces acting on submerged bodies under fluid flow conditions.

iv) CLO4: Analyze and perform calculations on open-channel flows, compute water surface profiles and hydraulic jump characteristics.

v) CLO5: Analyze the operating characteristics and performance of hydraulic turbines and pumps for engineering applications.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Flow through pipes Major and Minor losses through pipes; Hydraulic and energy grade lines; pipes in series and parallel; equivalent pipe; Transmission of power; Water Hammer and surge tanks: location and types, Analysis of pipe networks (Hardy-Cross method)
Module 2.	Boundary layer analysis Boundary layer thickness; Boundary layer over a flat plate; Laminar boundary layer; Application of momentum equation (von-Karman); Turbulent boundary layer; Hydrodynamically smooth and rough boundaries; Local and average friction coefficients; Separation of flow and its control
Module 3.	Fluid flow past submerged bodies Submerged Bodies: Forces on submerged bodies; Boundary layer development over submerged bodies; Drag force and lift force; Pressure drag and skin friction drag; Streamlined and Bluff bodies; Flow past flat plate, Flow past a sphere, Terminal Velocity of spherical bodies, Flow past a cylinder, Magnus effect and circulation
Module 4.	Flow in open channels Introduction, Classification of flows, Resistance formulae; Hydraulically efficient channel sections; Specific energy; Critical depth; Normal depth; Hydraulic jump and its characteristics, Gradually varied flow equations; Classification of water surface profiles; Computation of water surface profiles: step-by-step method and graphical integration method.
Module 5.	Hydraulic machines Turbines: classification; Impulse and reaction turbines; Unit quantities and specific speed; Cavitation; Draft tube, Types of Draft tubes Pumps: Centrifugal pumps: working principle and specific speed; Reciprocating pumps: working principle

CLO-PLO Mapping Matrix													
CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg. CLO
CLO1	3	3	2	3	0	2	2	0	2	2	0	2	1.75
CLO2	3	3	3	3	0	2	2	2	2	2	2	2	2.17
CLO3	3	2	0	3	2	0	0	1	2	0	0	1	1.17
CLO4	3	3	2	0	2	2	2	1	2	0	0	3	1.67
CLO5	3	2	3	0	2	2	2	1	1	2	2	2	1.83
Avg. PLO	3.0	2.6	2.0	1.8	1.2	1.6	1.6	1.0	1.8	1.2	0.8	2.0	1.7

S.No:	Text Books	Author	Publisher
1.	Fluid Mechanics and Hydraulic Machines	R.K. Bansal	Laxmi Publications (P) Ltd
2	Fluid Mechanics and Fluid Power Engineering	D. S Kumar	S. K. Kataria & Sons Publishers, New Delhi
	References		
1.	Fluid Mechanics	F. M. White	McGraw-Hill
2.	Open channel Flow	K. Subramanaya	Tata Mc Graw Hill, New Delhi.
3.	Engineering Fluid Mechanics	R. J. Garde, and A.G. Mirajgaokar	New Age International Publishers and Scitech Publications

List of Experiments

1	To find friction factors for pipes of different materials.
2	To determine the minor head loss coefficient for different pipe fittings.
3	To determine the surface profile and total head distribution of a vortex.
4	To determine the elements of a hydraulic jump in a rectangular channel.
5	To determine the Manning's rugosity coefficient of a laboratory flume.
6	To obtain the velocity distribution for an open channel and to determine the values of α, β, and n.

Course Code	BCIVLSC525					
Category	Lab Course					
Course Title	Survey Camp					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 5 (Fifth)
	-	-	-	-	1	
Pre requisites	Basic Surveying, Advanced Surveying, CAD					

Description of Survey Camp: Survey camp shall be conducted to provide hands-on experience in utilising surveying instruments. The survey should preferably be organized in a local area. Each student shall maintain a complete record of original field observations, computations, maps, contour plans, drawings, and the Survey Camp Report.

Course Learning Outcomes (CLOs)

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

i) CLO1. Demonstrate proficiency in handling and operating modern surveying instruments such as Total Station, GPS/GNSS, Auto Level, Theodolite, Compass, Plane Table, and other field equipment for engineering surveys.

ii) CLO2. Plan, execute, and document various engineering surveys for roads, buildings, bridges, dams, irrigation works, campuses, and other civil engineering projects while following standard field procedures.

iii) CLO3. Apply modern surveying technologies, including Electronic Distance Measurement (EDM), GPS/GNSS, photogrammetry, remote sensing, and digital mapping techniques in solving real-world civil engineering problems

iv) CLO4. Collect, analyze, reduce, and interpret field observations to prepare field books, contour maps, longitudinal and cross-sections, site plans, and engineering drawings using CAD software.

v) CLO5. Prepare comprehensive survey reports, technical drawings, computations, and project documentation while demonstrating teamwork, professional ethics, safety practices, effective communication, and project management skills.

Means of Assessment:

1. Practical work
2. Report Writing
3. Presentation
4. Drawing
5. Viva-voce

List of Activities

M. No:	Topic to Cover
Module 1.	Reconnaissance survey of the area or place of surroundings, familiarizing with survey equipment like digital theodolites, levels, total stations, and other surveying instruments for distance and angle measurement
Module 2.	Surveying of campus roads or proposed pathways using levels. This ensures proper grading and drainage. Preparation of Site Plan, Contour Map, L- Section & X–Section of the above works using AutoCAD
Module 3.	Contouring of parking lawn/ playgrounds/steep grounds by using Auto level and Total Station. Prepare a detailed contour map of a specific undulating open area or lawn within the campus to understand its topography.
Module 4.	Setting out and plot layout of building plans. Mark points and dimensions on the grounds for construction projects based on architectural drawings of the buildings.
Module 5.	Process and analyse survey data using software like AutoCAD or GIS to create detailed maps and prepare the Survey Camp Report.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	2	-	3	3	-	-	1	2	1	1	2	2.25
CLO2	3	3	2	3	3	2	2	-	2	1	2	2	2.55
CLO3	3	2	-	2	3	-	-	-	-	-	-	2	2.50
CLO4	3	3	2	3	3	-	-	-	1	2	-	2	2.56
CLO5	2	-	-	-	2	2	1	3	3	3	3	2	1.78
Avg PLO	2.25	2.4	1.6	2.4	2.8	2.5	2	2.75	2.8	2	1.5	2	2.3

S.No:	Text Books	Author	Publisher
1	Surveying, Volume I	Dr. B. C. Punmia, Ashok Kumar Jain & Arun Kumar Jain	Laxmi Publications
2	Surveying and Levelling	N. N. Basak	McGraw-Hill Education
	References		

3	Surveying, Volume II	Dr. B. C. Punmia, Ashok Kumar Jain & Arun Kumar Jain	Laxmi Publications
2	Surveying	S. K. Duggal	McGraw-Hill Education
3	Surveying and Geomatics	K. R. Arora	Standard Publishers Distributors

Course Code	BCIVCRC625					
Category	Programme Core Course					
Course Title	Design of Reinforced Concrete Structures					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 6 (Six)
	3	1	0	4	4	
Pre requisites	Strength of Materials, Structural Analysis, Concrete Technology, Building Materials, Construction Technology					

Course Learning Outcomes (CLOs)

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

i) **CLO1:** Explain material behaviour, design philosophies, and codal provisions (IS 456) for reinforced concrete design.

ii) **CLO2:** Analyse+ and design RCC beams for flexure, shear, torsion, and serviceability requirements.

iii) **CLO3***:* Design RCC slabs and understand bond, development length, and detailing requirements.

iv) **CLO4:** Analyze and design RCC columns under axial load and combined bending as per codal provisions.

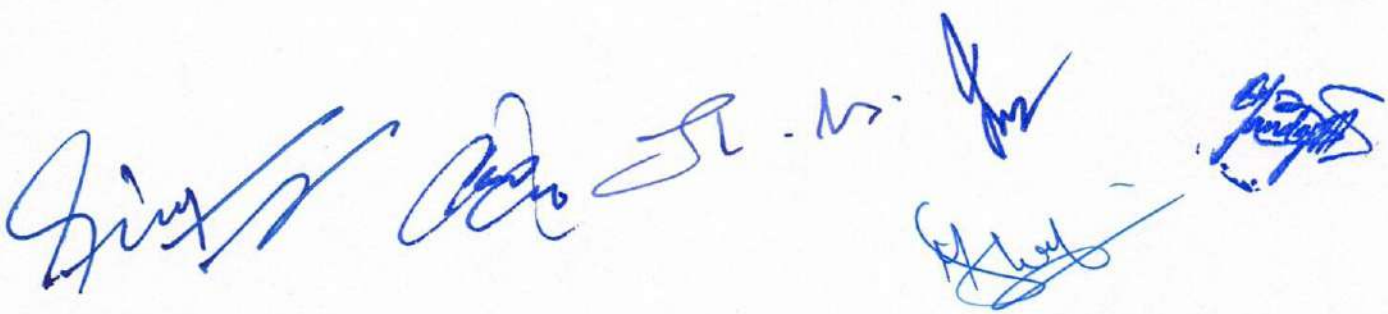
v) **CLO5:** Explain fundamentals of prestressed concrete including methods, losses, and analysis of prestressed members

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Stress-strain curves for concrete and steel; Characteristic strength; Design strength; IS specifications. Design philosophies: Working Stress Method, Ultimate Load Method, and Limit State Method of design. Probabilistic Analysis and Design, Characteristic strength and load, Partial safety factor, Codal recommendations
Module 2.	Analysis and design of flexural behaviour of reinforced concrete beams; Analysis and design of rectangular,T and L sections; codal provisions. Behaviour of RCC beams in shear; Design for shear; Anchorage and slipping of reinforcement. Torsion of beams and design; Detailing of reinforcement as per IS:456. Serviceability;limit state of deflection and cracking, calculation of deflection and codal requirements. Design Problems for Beams and checks for Codal Provisions.
Module 3.	Design of one-way and two-way RCC slabs with and without corners held down, design for bond, bond failure and strength, splicing of reinforcement, development length, detailing, introduction to design of slabs by Moment Coefficient Method. Introduction to flat slabs.
Module 4.	Types of RCC columns; short and long columns; Analysis and design of axially loaded RCC columns. Design of RCC columns for uni-axial and bi-axial moments; Helical reinforcement and transverse reinforcement.
Module 5.	Introduction to prestressed concrete. Advantages and disadvantages of prestressing; methods of prestressing; materials used in prestressed concrete; Pre-tensioning and post-tensioning systems; losses in prestress; Analysis of prestressed concrete symmetrical and unsymmetrical beams, Concept of kern, pressure line, load balancing method.

CLO-PLO Mapping Matrix													
CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	2	0	0	0	0	0	0	0	0	0	0	0.42
CLO2	3	3	3	2	2	0	0	0	0	0	1	0	1.17
CLO3	3	3	3	2	2	0	0	0	0	0	1	0	1.17
CLO4	3	3	3	2	2	0	0	0	0	0	1	0	1.17
CLO5	2	2	2	2	1	0	0	0	0	0	0	1	1.00
Avg PLO	2.8	2.6	2.2	1.6	1.4	0.0	0.0	0.0	0.0	0.0	0.6	0.2	0.98

S.No:	Text Books	Author	Publisher
1.	Reinforced Concrete Design	Pillai, S. U. and Menon	McGraw Hill Education Private Limited, New Delhi, India, 3rd Edition, 2009.
2	Prestressed Concrete	N. Krishna Raju	McGraw Hill
	References		
1.	Design of Reinforced Concrete Structures	Subramanian, N	Oxford University Press



Course Code	BCIVCFE625					
Category	Programme Core Course					
Course Title	Foundation Engineering					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 6 (Sixth)
	2	1	2	5	4	
Pre requisites	Soil Mechanics					

Course Learning Outcomes (CLOs)

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

i) CLO1: Understand the concept of shear strength and determine strength parameters through laboratory testing.

ii) CLO2: Understand the practical aspects of earth pressure and retaining structures.

iii) CLO3: Understand the concepts of slope stability along with its practical application.

iv) CLO4: Evaluate the bearing capacity of foundations and apply design principles for shallow and deep foundations.

v) CLO5: Select and recommend suitable soil stabilisation techniques for improving soil performance.

M.No:	Topic
Module 1.	Shear strength concept; Mohr-Coulomb equation; Laboratory determination: Direct shear test, Triaxial compression test under different drainage conditions (undrained, drained), unconfined compression test, Vane shear test, Strength envelope.
Module 2.	Lateral earth pressure, Rankine's theory of active and passive states; Lateral earth pressure under various conditions: Surcharge, sloping backfill; High-water table; Earth pressure diagrams, Total thrust, Tension cracks
Module 3.	Fundamental concepts, Types of slope failure, Analysis of infinite slopes, Methods of slope stability analysis; Stability considerations under: Submergence, Complete drawdown, Steady seepage conditions, Stability number
Module 4.	Basic definitions and principles related to bearing capacity, Methods of determining bearing capacity, Terzaghi's ultimate bearing capacity equation, Effects of: Size and shape of footing, Rigidity of footing, Footing types: Isolated footings, Raft foundations, Foundations on clays and sands; Pile foundations: Classification of piles, Determination of load-carrying capacity of piles, Pile groups and group efficiency, Negative skin friction
Module 5.	Purpose and need for soil stabilisation, Methods of stabilisation and applications: Mechanical stabilisation, Cement stabilisation, Lime stabilisation, Bituminous stabilisation, Chemical stabilisation; Brief introduction to: Shotcrete, Geo-reinforcement techniques

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	3	3	3	1	3	0	0	0	0	0	3	**1.58**
CLO2	3	3	3	3	1	3	0	0	0	0	0	3	**1.58**
CLO3	3	3	3	3	1	3	2	0	0	0	0	3	**1.75**
CLO4	3	3	3	3	3	3	0	1	2	1	1	3	**2.17**
CLO5	3	3	3	3	3	3	2	1	2	2	1	3	**2.42**
Avg PLO	**3**	**3**	**3**	**3**	**1.8**	**3**	**0.8**	**0.4**	**0.8**	**0.6**	**0.4**	**3**	**1.90**

S. No.:	Text Books	Author	Publisher
1.	Principles of Foundation Engineering	Braja M. Das	Thomson Asia Pvt. Ltd., Singapore
References			
1.	Physical and Geotechnical Properties of Soils	J.E. Bowles	McGraw-Hill Publishers
2.	Theoretical Soil Mechanics	Karl Terzaghi	Wiley, New York
3.	Soil Mechanics in Engineering Practice	Karl Terzaghi, Ralph B. Peck & Gholamreza Mesri	Wiley India / John Wiley & Sons

List of Experiments	
Experiment No.	Experiment Name
1	1-D Consolidation Test: To determine soil compressibility and settlement.
2	Direct Shear Test: To determine soil shear strength.
3	Unconfined Compressive Strength Test: To determine the undrainedshear strength of clay.
4	Unconsolidated Undrained Triaxial Test: To determine short-term shear strength.
5	Consolidated Undrained Triaxial Test: To determine shear strength after consolidation.
6	Vane Shear Test: To determine the in situ shear strength of soft clay.
7	Standard Penetration Test: To determine soil penetration resistance.
8	Plate Load Test: To determine the bearing capacity of soil.

5	**Rate Analysis of Civil Engineering Items** – Prepare detailed rate analysis for selected items such as brick masonry, RCC, plastering, and concrete flooring using the latest Schedule of Rates (SOR)
6	**Preparation of Detailed Cost Estimate** – Prepare a detailed estimate, abstract estimate, and cost summary for a residential building using prevailing SOR and market rates.
7	**Preparation of BOQ and Tender Documents** – Develop a Bill of Quantities (BOQ), Notice Inviting Tender (NIT), tender schedule, and contract documents for a small construction project
8	**Construction Site Visit for Quantity Verification** – Visit an ongoing construction site to verify executed quantities, compare them with estimated quantities, and identify causes of variations.
9	**Digital Quantity Take-Off Using CAD/BIM or Estimation Software** – Extract quantities from AutoCAD/Revit drawings or prepare estimates using MS Excel, CostX, PlanSwift, or equivalent software
10	**Mini Quantity Surveying Project** – Working in groups, prepare complete estimates, BOQ, rate analysis, project budget, and presentation for a small residential or institutional building, including field verification of selected quantities

CLO-PLO Mapping Matrix													
CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	3	2	2	1	1	0	0	2	1	0	0	**1.25**
CLO2	3	3	3	2	2	1	1	0	2	1	0	0	**1.5**
CLO3	3	3	3	3	2	1	1	0	1	2	0	0	**1.58**
CLO4	3	3	2	3	2	1	1	1	1	2	1	0	**1.75**
CLO5	3	2	2	2	3	2	2	1	1	1	1	1	**1.75**
Avg PLO	**3**	**2.8**	**2.4**	**2.4**	**2**	**1.2**	**1**	**0.4**	**1.4**	**1.4**	**0.4**	**0.2**	**1.56**

S.No:	Text Books	Author	Publisher
1.	Estimating and Costing in Civil Engineering	B.N. Dutta	UBS Publishers
References			
1.	J&K Schedule of Rates (JKSoR), Latest Edition.	-	Jammu & Kashmir Public Works Department (R&B),
2.	Delhi Schedule of Rates (DSR), Latest Edition.	-	Central Public Works Department (CPWD
3.	Estimating and Costing in Civil Engineering	D.D. Kohli & R.C. Kohli	S. Chand Publications.

Course Code	BCIVCIH625					
Category	Programme Core Course					
Course Title	Irrigation & Hydraulic Structures					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 6 (Sixth)
	2	1	0	3	3	
Pre requisites	Nil					

Course Learning Outcomes (CLOs)

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

i) CLO1: Understand the necessity, importance, and methods of irrigation, and analyse crop water requirements.

ii) CLO2: Analyse the soil-water- plant relationship and understand the crop water requirements.

iii) CLO3: Analyse canal irrigation systems and apply regime theories to estimate canal parameters, losses, and design considerations for efficient water conveyance.

iv) CLO4: Identify, classify, and explain the design principles of cross drainage works for safe and effective canal operation.

v) CLO5: Evaluate problems of water logging and soil salinity and recommend suitable drainage and reclamation measures for sustainable irrigated agriculture.

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Necessity and importance of irrigation in India; Advantages of irrigation; Types and methods of irrigation; Techniques of water distribution in farms; Soil moisture relationship and crop water requirements; Duty, Delta and Base Period; Crop period and consumptive use of water; Irrigation requirements.
Module 2.	Canal Irrigation: Types of canals and canal irrigation systems; Parts of a canal system; Canal alignment and assessment of water requirements; Estimation of canal losses; Design of irrigation channels; Regime theory and semi-theoretical approaches; Canal lining: types, advantages and design considerations.
Module 3.	Diversion Headworks: Selection of site and layout, Parts of diversion head works, types of weirs and barrages, Design of weirs on permeable foundations, control of silt entry into canal, Silt excluders and different types of silt ejectors
Module 4.	Cross Drainage Works: Necessity and classification of cross drainage works; Selection of suitable cross drainage structures; Types of cross drainage works: Aqueduct, Syphon aqueduct, Super passage, Syphon, Level crossing, Design principles of cross drainage works.
Module 5.	Water logging: Causes, preventive and curative measures, drainage of irrigated lands, saline and alkaline lands.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg. CLO
CLO1	3	2	0	0	0	0	3	0	0	0	0	0	0.67

CLO2	3	3	0	2	2	0	3	0	0	0	0	0	1.08
CLO3	3	3	3	2	2	0	2	0	0	0	0	0	1.25
CLO4	3	2	3	2	2	0	2	0	0	0	0	0	1.17
CLO5	3	3	2	2	2	0	3	0	0	0	0	0	1.25
Avg. PLO	3.00	2.60	1.60	1.60	1.60	0.00	2.60	0.00	0.00	0.00	0.00	0.00	

S.No:	Text Books	Author	Publisher
1	Irrigation and Hydraulic Structures.	S.K. Garg	Khanna Publishers
	References		
1.	Irrigation and Water Power Engineering	B.C. Punmia	Standard Publisher
2.	Irrigation and water resources engineering	G.L. Asawa	New Age International Publishers
3.	Irrigation, Water Power and Water Resources Engineering	K.R. Arora	Standard Publishers Distributors

Course Code	**BCIVCEE625**					
Category	**Programme Core Course**					
Course Title	**Environmental Engineering**					
Scheme and Credits	**L**	**T**	**P**	**No. of Hrs./Week**	**Credits**	**Semester- 6 (Sixth)**
	2	**1**	**0**	**3**	**3**	
Pre requisites	**Water Supply and Sanitation Engineering**					

Course Learning Outcomes (CLOs)

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

i) CLO1: Understand the sources and impacts of environmental pollution.

ii) CLO2: Calculate sewage flow and sewer design parameters.

iii) CLO3: Analyze the impact of sewage disposal on receiving water bodies.

iv) CLO4: Explain wastewater treatment processes.

v) CLO5: Evaluate solid waste and air pollution control methods.

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Sources and effects of land, water, and air pollution; Sewage—definition, types (domestic, industrial, etc.), and the need for sewage treatment, Elements of Sewage Management System, Types of Sewerage Systems.
Module 2.	Calculation of sewage flow (dry weather flow) and storm water flow, Sewage flow variations, Self-cleaning velocity, Types of sewers (circular and non-circular), Hydraulic design of circular sewers.
Module 3.	Composition of sewage, Characteristics of sewage, Tests for Oxygen demand (BOD, COD, TOC), Sewage disposal by dilution, Self-purification of streams, Oxygen-sag curve, Streeter-Phelps equation, Sewage disposal by land treatment.
Module 4.	Unit operations in sewage treatment, Classification of sewage treatment (Preliminary, Primary, Secondary etc.), Screening, Grit removal, Sedimentation, Activated sludge process, Filtration, Septic and Imhoff tanks.
Module 5.	Solid waste management: Classification, Composition, Quantity, and Collection of solid wastes. Methods of disposal of solid waste. Air pollution: Definitions, Sources of air pollution, Classification of air pollutants (primary and secondary), Effects of air pollution, Methods and Equipment to control air pollution.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg. CLO
CLO1	3	2	0	0	0	0	3	0	0	0	0	0	0.67
CLO2	3	3	2	2	2	0	2	0	0	0	0	0	1.17
CLO3	2	3	0	3	2	0	3	0	0	0	0	0	1.08

CLO4	3	2	2	2	2	0	3	0	0	0	0	0	1.17
CLO5	2	2	2	0	2	0	3	0	0	0	0	0	0.92
Avg. PLO	2.60	2.40	1.20	1.40	1.60	0.00	2.80	0.00	0.00	0.00	0.00	0.00	1.00

S.No:	Text Books	Author	Publisher
1.	Sewage Treatment Disposal and Wastewater Engineering	P. N. Modi	Sewage Treatment Disposal and Wastewater Engineering
	References		
1	Sewage Waste Disposal and Air Pollution Engineering	S.K. Garg	Sewage Waste Disposal and Air Pollution Engineering
2	Wastewater Engineering (Volume 1)	Metcalf & Eddy	McGraw-Hill Education
3	Water and Wastewater Technology	Mark J. Hammer Sr. Mark J. Hammer Jr.	Pearson Education Limited

Course Code	BCIVLTE625					
Category	Lab Course					
Course Title	Traffic Engineering and Road Facilities					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 6 (Sixth)
	0	1	4	5	3	
Prerequisites	Engineering Graphics, Basic Surveying, Highway Engineering,					

Course Learning Outcomes (CLOs)

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

i) **CLO1: Understand** the fundamental concepts of traffic engineering, traffic stream characteristics, pedestrian facilities, highway capacity, and transportation planning

ii) **CLO2: Compare** different traffic control devices, intersection control methods, Level of Service (LOS) criteria, and Indo-HCM with US-HCM for traffic analysis

iii) **CLO3: Interpret** data obtained from traffic studies, including speed, traffic volume, parking, accident, and origin-destination (OD) studies for traffic management and planning

iv) **CLO4: Draw** traffic control layouts, road markings, intersection designs, traffic rotaries, and signal timing plans using standard engineering practices

v) **CLO5: Integrate** appropriate traffic management and transportation planning solutions by travel demand modelling

Theory Module (Internal Evaluation)

M. No.:	Topic
Module 1.	Introduction to traffic engineering: Components and characteristics of traffic stream, pedestrian facilities, and flow characteristics
Module 2.	Highway Capacity and Level-of-Service Analysis: Design traffic volume, PHF, Concept of LOS, Indo HCM vs US HCM.
Module 3.	Traffic studies Speed and Traffic volume studies, Accident studies, Parking studies, OD studies
Module 4.	Traffic control and Intersection design Traffic signs, road markings, Types of intersections and controls, Design of traffic rotaries, Signal design by Webster's method
Module 5.	Transportation Planning and Analysis: Introduction to urban and regional transportation planning, Travel demand modeling—trip generation, mode and destination choice, highway route choice

Activity Module	
1	**Traffic Volume Count Survey** – Conduct classified traffic volume counts at a selected urban intersection or highway section during peak and off-peak hours. Determine Average Daily Traffic (ADT), Peak Hour Volume (PHV), and Peak Hour Factor (PHF).
2	**Speed Study** – Perform spot speed studies using radar guns/mobile applications or stopwatch methods and determine average speed, 85th percentile speed, pace speed, and speed distribution.

3	**Level of Service (LOS) Assessment** – Evaluate the operational performance of a selected road segment or intersection using Indo-HCM/HCM procedures and recommend improvements.
4	**Pedestrian Facilities Audit** – Survey pedestrian infrastructure such as footpaths, crossings, ramps, and signage around the campus or commercial areas. Suggest measures to improve pedestrian safety and accessibility
5	**Road Safety and Accident Analysis** – Collect accident data from police records or public databases for a selected location, identify accident-prone spots (black spots), analyze causes, and propose remedial measures.
6	**Parking Survey** – Conduct on-street or off-street parking studies to determine parking accumulation, duration, turnover, occupancy, and parking index. Recommend parking management strategies.
7	**Intersection Study and Traffic Control Evaluation** – Observe an existing intersection to evaluate traffic signs, road markings, channelization, and signal operations. Design suitable traffic control improvements based on IRC guidelines.
8	**Traffic Signal Design Using Webster's Method** – Collect turning movement counts at a signalized intersection and compute optimum cycle length, green time allocation, and signal phasing using Webster's method.
9	**Origin–Destination (OD) Survey and Travel Pattern Analysis** – Conduct a sample OD survey using questionnaires or mobile-based surveys to study travel behavior, trip purpose, and modal choice
10	**Transportation Planning Mini Project** – Prepare a transportation improvement proposal for a selected locality by integrating traffic surveys, LOS analysis, pedestrian facilities, parking management, intersection improvements, and travel demand assessment. Present findings using GIS/CAD and technical reports.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	2	1	1	0	1	2	0	0	0	0	1	0.92
CLO2	2	3	2	2	1	0	2	0	0	0	0	1	1.08
CLO3	2	3	2	3	2	1	2	0	1	2	1	2	1.75
CLO4	2	2	3	2	3	0	1	0	1	3	0	1	1.5
CLO5	3	3	3	2	2	2	3	1	2	2	2	2	2.2
Avg PLO	2.4	2.6	2.2	2	1.6	0.8	2	0.2	0.8	1.4	0.6	1.4	1.49

S.No:	Text Books	Author	Publisher
1.	Traffic Engineering and Transportation Planning	L.R. Kadiyali	Khanna Publishers
	References		
1.	Fundamentals of Transportation Engineering	Ricardo G. Sigua	UP Press
2.	Indo-HCM (Indian Highway Capacity Manual)	CSIR-Central Road Research Institute	
3.	Transportation Engineering	C.J. Khisty & B. Kent Lall	Pearson Education

Course Code	BCIVODM625					
Category	Open Elective Course					
Course Title	Disaster Management and Preparedness					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 6 (Sixth)
	3	0	0	3	3	
Pre requisites	Nil					

Course Learning Outcomes (CLOs)

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

i) **CLO1:** Explain fundamental concepts of disasters, hazards, vulnerability, and disaster classification.

ii) **CLO2:** Analyse causes, impacts, and trends of natural and man-made disasters, including climate and socio-economic aspects.

iii) **CLO3:** Apply disaster preparedness strategies, early warning systems, and institutional frameworks for risk reduction.

iv) **CLO4:** Evaluate disaster response mechanisms, including rescue, relief, and emergency management practices.

v) **CLO5:** Propose sustainable reconstruction, rehabilitation, and disaster-resilient engineering solutions.

Theory Module (Internal and External Evaluation)

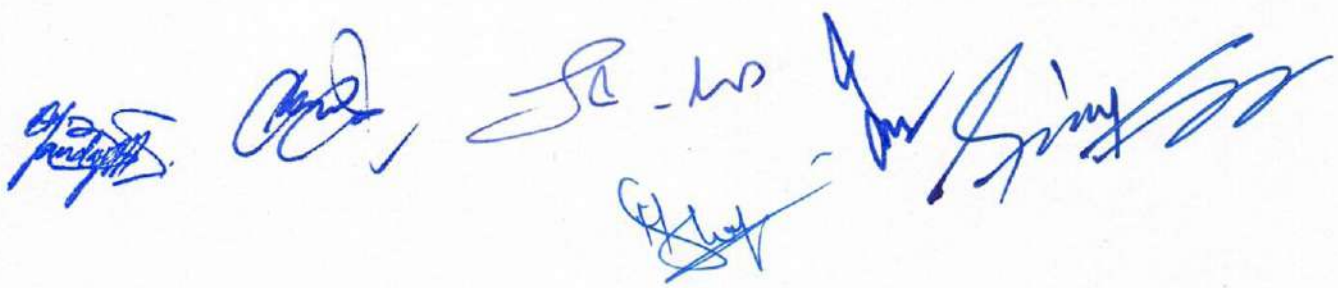
M.No:	Topic
Module 1.	Concepts and definitions: disaster, hazard, vulnerability, risk, severity, frequency, capacity, impact, prevention, preparedness, mitigation; Types and classification of disasters: Natural disasters: flood, cyclone, earthquakes, tsunami, volcanoes, landslides, coastal erosion, soil erosion, forest fires, Man-made disasters: fire, industrial pollution, chemical spills, nuclear disasters, biological disasters, transportation accidents (air, sea, rail, road), structural failures (buildings and bridges), war and terrorism Causes, effects, and practical examples of disasters.
Module 2.	Environmental, physical, and social impacts; economic and political impacts; health and psychosocial issues; demographic impacts (age, gender, special needs); global and national disaster trends; climate change and urban disasters; post-disaster environmental problems (water safety, waste management, disease control, sanitation, food safety); impact of development projects on vulnerability (dams, land-use changes, urbanization).
Module 3.	Concept and nature of disaster preparedness plans; prediction and early warning systems; Roles in preparedness: government, community, NGOs, international agencies, local institutions, engineers (civil engineering focus); use of IT in communication systems; disaster management policies; Disaster Risk Reduction (DRR); National Disaster Management Authority (NDMA); and other Indian agencies.
Module 4.	Disaster response: concept and phases; disaster response plan; activation of emergency preparedness plan; search and rescue operations; evacuation planning; logistic and resource management; structural vs non-structural measures; medical health response; trauma and psychology (rumors, panic, stress management); relief and recovery actions.
Module 5.	Reconstruction and rehabilitation as development; damage assessment; post-disaster effects and remedial measures; Long-term job creation; reconstruction techniques and disaster-resistant construction; sustainable and environment-friendly recovery; role of education and awareness; Dealing

	with victims, long-term counter-disaster planning; community-based and environment-friendly approaches.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	2	0	0	0	2	3	0	0	0	0	0	0.83
CLO2	2	3	2	2	0	2	3	0	0	0	0	0	1.33
CLO3	2	3	2	2	2	3	3	0	2	1	1	0	1.75
CLO4	2	2	2	2	2	3	2	1	2	2	1	0	1.75
CLO5	2	3	3	2	2	3	3	1	2	1	1	1	2.00
Avg PLO	2.2	2.6	1.8	1.6	1.2	2.6	2.8	0.4	0.8	0.8	0.6	0.2	1.53

S.No:	Text Books	Author	Publisher
1.	Disaster Management	Dr. Mrinalini Pandey	Wiley India Pvt. Ltd
2	Introduction to International Disaster Management	Damon P. Coppola	Butterworth-Heinemann
	References		
1.	Handbook of Disaster Management: Techniques & Guidelines	Singh B. K	2008, Rajat Publication
2.	Disaster Science and Management	Tushar Bhattachary	McGraw Hill Education



Course Code	BCIVORE625					
Category	Open Elective Course					
Course Title	Renewable Energy Technologies					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 6 (Sixth)
	3	0	0	3	3	
Pre requisites	Nil					

Course Learning Outcomes (CLOs)

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

***i)* CLO1:** Explain different energy sources, their availability, and significance of renewable energy systems.

***ii)* CLO2:** Analyze solar energy systems, including radiation geometry and measurement techniques.

***iii)* CLO3:** Evaluate wind and biomass energy systems, including conversion technologies and performance factors

***iv)* CLO4:** Explain principles and applications of emerging energy systems such as geothermal, hydrogen, fuel cells, MHD, and OTEC

***v)* CLO5:** Assess the potential, advantages, and limitations of renewable energy technologies for sustainable development.

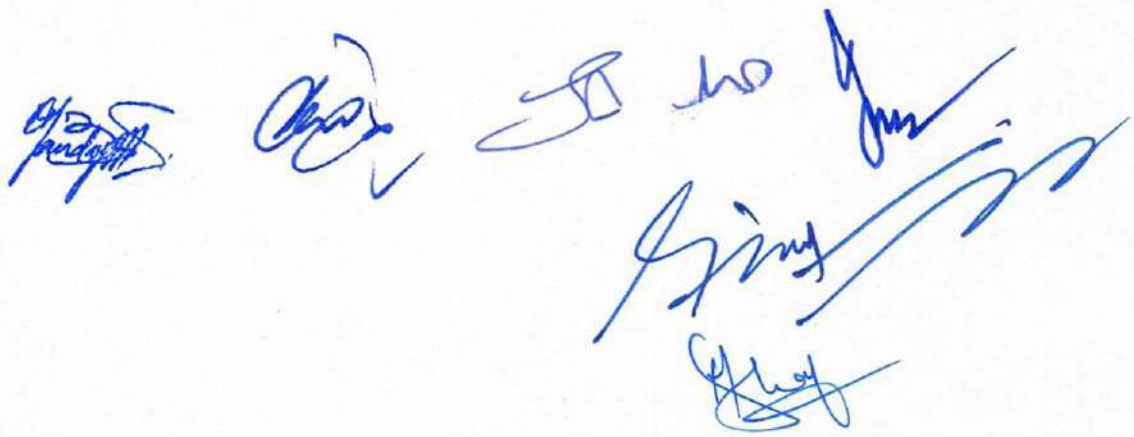
Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Energy Sources & Availability: Conventional, non-conventional, renewable, non-renewable sources of energy, prospects, advantages. Introduction to different types of nonconventional sources of energy: solar, wind, biomass, Ocean Thermal Energy Conversion (OTEC), geothermal, hydrogen energy, fuel cells, MHD, thermionic power conversion, thermoelectric power conversion.
Module 2.	Solar Energy: Solar constant, solar radiation geometry, local solar time, day length, solar radiation measurement, radiation on inclined surfaces, solar radiation data, solar charts.
Module 3.	Wind Energy: Wind as a source of energy, characteristics of wind, wind data. horizontal-vertical axis wind turbines
Module 4.	Introduction to biomass, biofuels & their heat content, biomass conversion technologies. Aerobic & anaerobic digesters, factors affecting bio-digestion, biogas plants–types, description, utilisation of biogas, Biomass gasification: Gasifier types, direct thermal application of gasifiers, Advantages & problems in development of gasifiers
Module 5.	Other Renewable Energy Sources: Geothermal Energy: Status & estimates, geothermal resources, geothermal systems & their characteristics, Hydrogen energy, Fuel Cells: Principle, classification, types; MagnetoHydroDynamic (MHD) power conversion: Principle, types; Ocean Thermal Energy Conversion (OTEC); Tidal energy; Wave energy.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	2	0	0	0	2	3	0	0	0	0	0	0.83
CLO2	3	3	2	2	2	0	3	0	0	0	0	0	1.42
CLO3	2	3	2	2	2	0	3	0	0	0	0	0	1.33
CLO4	2	2	2	2	2	0	3	0	0	0	0	1	1.17
CLO5	2	3	3	2	2	2	3	1	2	1	1	1	2.00
Avg PLO	2.4	2.6	1.8	1.6	1.6	0.8	3.0	0.2	0.4	0.2	0.2	0.4	1.35

S.No:	Text Books	Author	Publisher
1.	Non-Conventional Energy Resources	G D Rai	Khanna Publisher
	References		
1.	Renewable Energy Engineering and Technology: Principles and Practice	V. V. N. Kishore	Routledge



Course Code	BCIVOGB625					
Category	Open Elective Course					
Course Title	Green Buildings					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 6 (Sixth)
	3	0	0	3	3	
Pre requisites	Nil					

Course Learning Outcomes (CLOs)

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

i) **CLO1:** Explain concepts of global warming, carbon footprint, and the role of buildings in environmental sustainability.

ii) **CLO2:** Analyze green building features, energy-efficient systems, and life cycle cost of buildings.

iii) **CLO3:** Apply environment-friendly construction technologies and sustainable materials in building design.

iv) **CLO4:** Evaluate green building rating systems and principles of sustainable building design.

v) **CLO5:** Propose sustainable solutions for energy, water, and waste management in buildings.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Global warming: Definition, Causes and Effects, Contribution of buildings towards global warming, Carbon footprint, Global efforts to reduce carbon Emissions, Green buildings: (definition, features, necessity, environmental benefit, economical benefits, health and social benefits); major energy-efficient areas for buildings, Embodied energy in materials, green materials, Comparison of initial cost of green Vs conventional building, life cycle cost of buildings
Module 2.	Environment friendly building technologies, Net Zero Energy Buildings (NZEB), alternative masonry techniques such as rat trap bond, cavity walls, sustainable materials including fly ash bricks, AAC blocks, hollow blocks, ferrocement, bamboo, recycled aggregates and geopolymer materials; precast and prefabricated components (beams, columns, door and window frames); alternative roofing systems; modern systems (pre-engineered buildings, modular prefabrication)
Module 3.	Green building rating Systems, BREEAM, LEED, GREEN STAR, GRIHA, Green rating for integrated habitat assessment for new buildings, Point system with differential weightage; Green design: (definition, principles of sustainable development in building design)
Module 4.	Utility of solar energy in buildings, Concepts of solar passive cooling and heating of buildings. Low-Energy Cooling. Case studies of solar-passive cooled and heated buildings.
Module 5.	Water utilisation in Buildings, low-energy approaches to water management; Management of solid wastes. Management of sullage water and sewage. Urban environment, green cover, and built environment.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	2	0	0	0	2	3	0	0	0	0	0	0.83
CLO2	3	3	2	2	2	2	3	0	0	0	1	0	1.50
CLO3	2	3	3	2	2	2	3	0	0	0	1	0	1.50
CLO4	2	2	3	2	2	2	3	1	0	0	1	0	1.50
CLO5	2	3	3	2	2	3	3	1	2	1	1	1	2.00
Avg PLO	2.4	2.6	2.2	1.6	1.6	2.2	3.0	0.4	0.4	0.2	0.8	0.2	1.44

S.No:	Text Books	Author	Publisher
1.	Handbook of Green Building Design and Construction	Sam Kubba	Butterworth-Heinemann
	References		
1.	Green Building Fundamentals	HarharaIyer G,	Notion Press