Course Code	BCIVCEH725					
Category	Programme Core Course					
Course Title	Engineering Hydrology					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	3	0	0	3	3	
Pre requisites	Fluid Flow in Pipes & Channels					

Course Learning Outcomes (CLOs)

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

i) CLO1: Analyze the hydrological cycle and estimate various hydrological processes, including precipitation, evaporation, evapotranspiration, infiltration, and runoff, using standard hydrological methods.

ii) CLO2: Analyze streamflow data and apply hydrograph analysis techniques to determine runoff characteristics, base flow separation, and unit hydrograph parameters.

iii) CLO3: Apply flood estimation and routing techniques to analyze flood design and evaluate reservoir and channel routing for water resources planning.

iv) CLO4: Analyze groundwater movement through aquifers by applying Darcy's law, well hydraulics, and groundwater flow principles to engineering problems.

v) CLO5: Analyze reservoir planning and parameters to determine storage capacity, yield, sedimentation characteristics, and reservoir performance for water resource management.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Hydrology and Hydrological Abstractions Hydrologic cycle; Forms of precipitation; Rainfall and its measurement; Rain gauge network and missing rainfall data; Hyetographs and methods of determining average rainfall; Hydrological abstractions; Water budget equation; Factors affecting and methods of determining evaporation; Transpiration; Evapotranspiration; Infiltration and Infiltration indices
Module 2.	Stream Flow Measurements and Hydrographs Direct and indirect methods of stream flow measurement; Stage-discharge relationship; Factors affecting runoff; Rainfall-runoff relationships; Storm hydrograph; Components of hydrograph and base flow separation; Effective rainfall; Unit hydrograph: Derivation, applications, and limitations
Module 3.	Flood Estimation and Modelling Occurrence and distribution of floods; Flood estimation methods: Rational method, Empirical methods, Unit hydrograph method; Flood routing: Reservoir routing (Modified Puls method), Channel routing (Muskingham method)
Module 4.	Groundwater Hydrology Occurrence and distribution of groundwater; Geological formations and types of aquifers; Aquifer properties; Darcy's law; Pumping tests; Well hydraulics: Steady flow to confined and unconfined aquifers
Module 5.	Reservoir Design Studies Investigations for reservoir planning; Selection of site for a reservoir; Types of reservoirs; Determination of storage capacity and yield using mass curve technique; Reservoir sedimentation and Trap efficiency; Life of reservoirs; Sediment control measures

CLO-PLO Mapping Matrix													
CLO \ PLO	PLO 1	PLO 2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg. CLO
CLO1	3	2	2	2	1	0	2	2	2	2	0	3	1.75
CLO2	3	3	2	0	3	2	3	2	0	0	3	2	1.92
CLO3	3	3	2	2	0	0	3	1	0	2	2	2	1.67
CLO4	3	2	2	3	0	0	2	1	0	2	1	2	1.5
CLO5	2	2	3	2	2	2	3	2	2	2	3	2	2.25
Avg. PLO	2.8	2.4	2.2	1.8	1.2	0.8	2.6	1.6	0.8	1.6	1.8	2.2	1.82

S.No:	Text Books	Author	Publisher
1.	Engineering Hydrology	Subramanya, K.	Tata McGraw-Hill, New Delhi.
2	Irrigation and Water Power Engineering	Punmia, B.C.	Standard Publishers.
	References		
1.	Irrigation, Water Power, and Water Resources Engineering	Arora, K.R.,	Standard Publishers Distributors, Delhi.
2.	Engineering Hydrology	Wilson, E.M.,	ELBS, English Language Book Society, Macmillan Education Ltd., London.

Course Code	BCIVLQS725					
Category	Lab Course					
Course Title	Quantity Survey & Cost Estimation					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	0	1	4	5	3	
Pre requisites	Building Materials and Construction, Basic Surveying, Computer Aided Civil Engineering Drawing					

Course Learning Outcomes (CLOs)

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

i). CLO1: Interpret engineering drawings and identify quantities of various civil engineering components.

ii). CLO2: Perform quantity measurements for building and infrastructure works using standard methods.

iii). CLO3: Prepare rate analyses and detailed cost estimates for construction projects.

iv). CLO4: Prepare Bills of Quantities (BOQ), tender documents, and project cost reports.

v). CLO5: Apply modern tools, software, and field measurement techniques for practical quantity surveying and cost management.

Theory Module (Internal Evaluation)

M.No:	Topic
Module 1.	Introduction to quantity surveying and cost estimation. Methods of measurement as per relevant standards. Units and modes of measurement. Interpretation of architectural and structural drawings. Introduction to schedule of rates (SOR), and State Schedule of Rates (SSR).
Module 2.	Estimation of earthwork and foundations. Quantity calculations for masonry works. Estimation of reinforced cement concrete (RCC) works and reinforcement. Flooring, roofing, plastering, painting, and finishing works. Preparation of quantity take-off sheets. Basic Estimation of Building Services (water supply, sanitary, and electrical works).
Module 3.	Material, labour and equipment requirements. Analysis of rates for major civil engineering items. Preparation of detailed estimate, abstract estimate, revised estimate and supplementary estimate. Cost computation using prevailing market rates and SOR.
Module 4.	Preparation of bills of quantities (BOQ), tender documents and contract schedules. Cost control and project budgeting. Valuation principles and depreciation concepts. Introduction to quantity surveying in project management.
Module 5.	Introduction to estimation software and digital quantity take-off. Spreadsheet-based estimation and cost analysis. Quantity extraction from CAD/BIM drawings. Field verification of quantities and measurements.

Activity Module	
1	**Interpretation of Engineering Drawings** – Study architectural and structural drawings of a residential building and identify all measurable components required for quantity estimation
2	**Field Measurement of Building Components** – Measure dimensions of an existing building (classroom, laboratory, or residential unit) using measuring tapes/laser distance meters and prepare measurement sheets as per IS 1200
3	**Preparation of Quantity Take-Off Sheets** – Compute quantities of earthwork, brick masonry, RCC, plastering, flooring, and painting for a simple building using engineering drawings
4	**Estimation of Building Services** – Estimate quantities and approximate costs for water supply, sanitary, and electrical installations of a small building

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	BCIVCDS725					
Category	Programme Core Course					
Course Title	Design Of Steel Structures					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	2	1	0	3	3	
Pre requisites	Physics, Mathematics, Strength of Materials. Structural analysis, Analysis of Indeterminate Structures.					

Course Learning Outcomes (CLOs)

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

***i)* CLO1:** Identify different types of structural steel and explain design philosophies.

***ii)* CLO2:** Design riveted, bolted, and welded joints under axial and shear loads and assess their efficiency and failure modes, including eccentric connections.

***iii)* CLO3:** Analyze and design axially loaded compression members, determine effective length, and detail built-up columns with lacing and batten plates.

***iv)* CLO4:** Analyze and design axial loaded tension members using limit state design and built-up sections

***v)* CLO5:** Analyze and design beams considering plastic behaviour, laterally supported/unsupported conditions, and uniaxial/biaxial loading

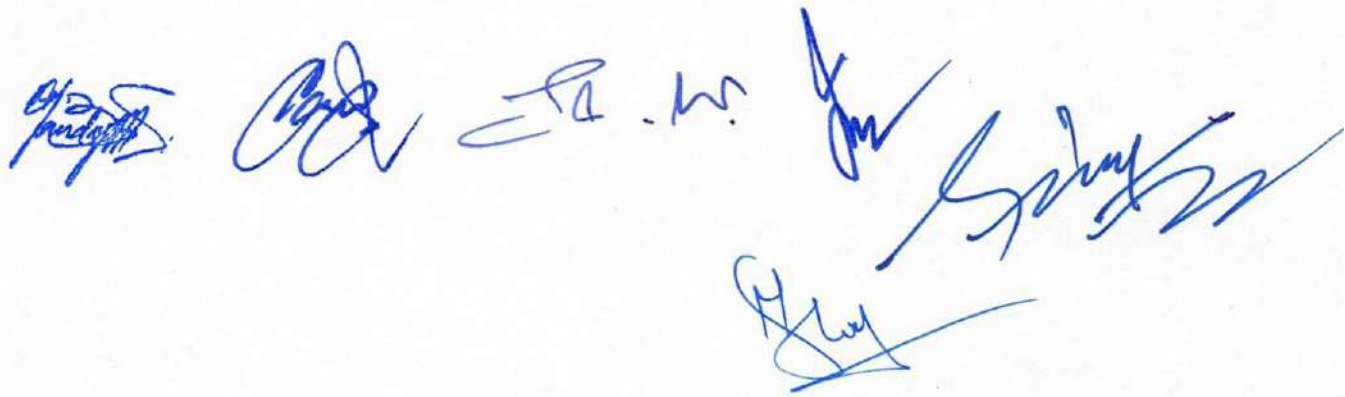
Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Introduction: Structural elements, Types of steel sections, Design philosophy, and Design methods. Working loads and factored loads.
Module 2.	Connections: Riveted, bolted, and welded connections; failure of joints; efficiency of joints; design of bolted, riveted, & welded joints for axial and shear force; HS friction bolts; Design of eccentric connections.
Module 3.	Compression members: Design of compression members for axial force, effective lengths, built-up columns, Design of lacing and batten plates
Module 4.	Tension members: Steel members subject to axial tension, L.S. Design of tension members, Design rules, Built-up sections.
Module 5.	Flexural members: Plastic analysis, laterally supported and unsupported beams, Stability consideration, uniaxial loading, and biaxial loading.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	2	3	2	0	1	1	1	0	0	0	1	1.17
CLO2	3	3	2	3	0	1	1	1	0	0	0	0	1.17
CLO3	3	3	2	3	0	1	1	1	0	0	0	0	1.17
CLO4	3	3	2	3	0	1	1	1	0	0	0	0	1.17
CLO5	3	3	2	3	0	1	1	1	0	0	0	0	1.17
Avg PLO	3	2.8	2.2	2.8	0	1	1	1	0	0	0	0	1.17

S.No:	Text Books	Author	Publisher
1.	Design of steel structures: Theory and practice	N. Subramanian.	Oxford University Press
2	Limit state design of steel structures	Shashi Kant Duggal	Tata McGraw Hill
	References		
1.	Structural steel design	J. C. McCormac.	Prentice Hall
2.	Design of steel structures	E. H. Gaylord.	Tata McGraw-Hill
3.	Limit state design of steel structures	V.L. Shah and V. Gore	Structures



Course Code	BCIVDSD725					
Category	Programme Elective Course					
Course Title	Structural Dynamics					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	2	1	2	5	4	
Pre requisites	Physics, Mathematics, Strength of Materials, Structural analysis, Analysis of Indeterminate Structures.					

Course Learning Outcomes (CLOs)

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

i) **CLO1:** Understand the fundamental principles of structural dynamics for single and multi-degree of freedom systems

ii) **CLO2:** Analyze natural frequencies, mode shapes, and damping ratios of dynamic systems

iii) **CLO3:** Analyze the dynamic response of structures under harmonic, impulse and earthquake excitations using numerical techniques.

iv) **CLO4:** Formulate the equation of motion for generalized SDOF dynamic problems

v) **CLO5:** Evaluate modal participation and use modal superposition to estimate response of MDOF systems

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Introduction to basic concepts of Structural Dynamics: Concept of vibration, Causes of vibrations, Types of vibrations, consequences of vibration, vibration control in structural design, Dynamic loading, Causes of dynamic loadings, Response of the system, Degrees of Freedom, Simple harmonic motion.
Module 2.	Single Degree of Freedom Systems: Analysis of Free Vibrations – undamped and damped systems, estimation of damping by logarithmic decrement method
Module 3.	Formulation of equation of motion for generalized SDOF dynamic problems using virtual work method, Response of SDOF systems to Harmonic, Periodic and Impulse Loads
Module 4.	Formulation of equation of motion for multiple DOF systems. Finding mode shapes and frequencies by solving the determinantal equation and iterative techniques. Use of sweeping matrices for obtaining higher modes. Proof of Convergence. Modal superposition and Response Spectrum Methods.
Module 5.	Response of single and multiple DOF systems to Earthquake Loading using Time Stepping, Methods based on Forward Cauchy Euler, Backward Cauchy Euler and Trapezoidal Rule. Accuracy, stability and algorithmic damping in step-by-step methods.

CLO-PLO Mapping Matrix													
CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	2	3	2	0	1	1	1	0	0	0	1	1.17
CLO2	3	3	2	3	0	1	1	1	0	0	0	0	1.17
CLO3	3	3	2	3	0	1	1	1	0	0	0	0	1.17
CLO4	3	3	2	3	0	1	1	1	0	0	0	0	1.17
CLO5	3	3	2	3	0	1	1	1	0	0	0	0	1.17
Avg PLO	3	2.8	2.2	2.8	0	1	1	1	0	0	0	0	1.17

S.No:	Text Books	Author	Publisher
1.	Dynamics of Structures	A. K. Chopra.	Pearson Education
2	Structural Dynamics	Mario Paz and William Leigh.	CBS
	References		
1.	Dynamics of Structures	R.W Clough & J. Penzin.	McGraw Hill
2.	Advanced Dynamics	S. Timoshenko.	McGraw Hill
3.	Introduction of Structural Dynamics	J.M. Biggs.	McGraw Hill

List Of Experiments	
S.No.	**Name of Experiment**
1.	Free vibration of a simple pendulum: To study undamped free oscillations of a simple pendulum and determine the natural frequency of oscillations.
2.	Free vibration of a spring mass: To study undamped free vibrations of a spring-mass system and to determine the natural frequency of vibrations.
3.	Forced Vibration of S.D.O.F System: To study forced vibrations of a SDOF system and determine the natural frequency of vibrations.
4.	Vibration of M.D.O.F system: To find out natural frequencies and natural mode shapes of multi-degree of freedom system
5.	Free vibration of a damped second order system: To study the free vibration of a damped second order system and determine the frequency of damped vibrations. Also, draw the decay curve and determine the logarithmic decrement.
6.	Vibration in beams: To study the vibrations of different types of beams.
7.	Vibration Control of a structure: To understand how dampers or isolators can control vibration of structures

Course Code	BCIVDNM725					
Category	Programme Elective Course					
Course Title	Numerical Methods					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	3	1	0	4	4	
Pre requisites	Calculus and Linear Algebra.					

Course Learning Outcomes (CLOs)

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

i) **CLO1: Solve** algebraic and transcendental equations using numerical methods for real world problem solving.

ii) **CLO2: Apply** numerical techniques to solve linear systems of equations in scientific and engineering computations.

iii) **CLO3: Use** interpolation methods to approximate functions in data analysis and modelling.

iv) **CLO4: Compute** derivatives and integrals for complex mathematical and physical problems.

v) **CLO5: Solve** ordinary differential equations numerically for dynamic system modelling and simulations.

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Finite Difference and Interpolation: Difference Table and its usage. The difference operators Δ, ∇ and the operator E. Interpolation with equal intervals, Newton's advancing difference formula. Newton's backward difference formula. Interpolation with unequal intervals. Newton's divided difference formula. Lagrange's interpolation formula.Spline functions.
Module 2.	Central Differences: The central difference operator δ and the overraging operator μ. Relations between the operators.Gauss forward and backward interpolation formula, Sterling's, Bessel's, Laplace and Everett's formulae
Module 3.	Numerical solution of algebraic and Transcendental Equations: Equations Graphic Method, Regula-Fast method, Balzano's Process of bisection of intervals, Newton-Raphson Method and its geometrical significance.
Module 4.	Numerical Integration: Numerical Integration, General Quadrature Formula, Simpson's one-third and three-eight rules, Weddles' rule, Hardy's rule, Trapezoidal rule.
Module 5.	Numerical Solution of ordinary differential equations : Picard's method. Numerical solution of ordinary differential equations, Taylor's series method, Euler's method, Runge-Kutta Method.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg PLO
CLO1	3	3	1	2	2	0	0	0	0	0	0	1	1
CLO2	3	3	2	2	2	0	0	0	0	0	0	1	1.08
CLO3	3	3	2	3	2	0	0	0	0	0	0	1	1.17
CLO4	3	3	2	3	2	0	0	0	0	0	0	2	1.25
CLO5	3	3	3	3	2	0	0	0	0	0	0	2	1.33

Avg PLO	3	3	2	2.60	2	0	0	0	0	0	0	1.40	1.17

S.No:	Text Books	Author	Publisher
1.	Introductory Methods in Numerical Analysis	S. S. Sastry	PHI Learning Pvt Ltd
2	Mathematical Numerical Analysis	S. C. Scarborough	CBS Publishers & distributors
	References		
1.	Numerical Methods for scientists and Engineering	M..K.. Jain, S.R. Iyenger 7 R. K. Jain	New age publications
2.	Numerical Methods for Mathematics, Science and Engineering	J. H. Mathews	Prentice hall college division
3.	Theory and Problems in Numerical methods	T. Veerrarjan and T.Ramachandra	Tata McGraw-Hill

Course Code	BCIVDAD725					
Category	Programme Elective Course					
Course Title	Airport, Dock and Harbour Engineering					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	3	1	0	4	4	
Pre requisites						

Course Learning Outcomes (CLOs)

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

i) **CLO1**: Explain airport planning principles, aircraft characteristics, airport components, and site selection criteria.

ii) **CLO2:** Design runway orientation, runway length, and geometric elements considering operational and environmental factors.

iii) **CLO3**: Analyze the planning and design of taxiways, aprons, terminal facilities, airport lighting, and air traffic control systems.

iv) **CLO4:** Explain harbour planning principles and assess the effects of oceanographic factors on harbour design.

v) **CLO5:** Analyze and design major harbour and port structures including breakwaters, docks, quays, jetties, and cargo handling facilities.

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Introduction to airport engineering: Airport planning concepts, Components of an airport, Functions of airport components, Airport classification, Aircraft characteristics affecting airport planning, Airport site selection, Airport master planning, Airport zoning, Obstruction criteria, Safety requirements
Module 2.	Runway Engineering: Wind rose diagram, Runway orientation, Basic runway length, Corrections for: elevation, temperature and gradient, Numerical problems on runway length, Runway geometric design, Runway width, Longitudinal slope, Transverse slope, Camber, Runway safety areas.
Module 3.	Taxiways and Airport Facilities: Taxiway planning, Taxiway layout, Factors affecting taxiway design, Taxiway geometry, Exit taxiways, Holding bays, Turning radius, Aprons, Aircraft parking systems, Airport markings, Airport lighting, Visual aids, Air Traffic Control (ATC), Instrument Landing System (ILS).
Module 4.	Docks and Harbours: Classification of harbours, Components of harbours, Site selection, Harbour planning ,Requirements of a good harbour, Layout of harbours, Wet docks, Dry docks, Construction and maintenance of docks.
Module 5.	Harbour Structures: Breakwaters, Lock gates, Quays, Jetties, Landing piers, Dolphins, Fenders, Slipways, Aprons, Transit sheds, Warehouses.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO9	PLO1 0	PLO 11	PLO 12	Avg. PLO
CLO1	3	2	1	1	1	1	2	0	0	0	0	1	1
CLO2	3	3	3	2	2	2	3	1	0	1	2	1	1.9

CLO3	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**2.25**
CLO4	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**1**	**0**	**0**	**1**	**1**	**1.75**
CLO5	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**1**	**1**	**3**	**2**	**2.4**
Avg. CLO	**3**	**3**	**2.4**	**2.2**	**2.2**	**2**	**2.6**	**1.2**	**0.4**	**0.6**	**1.6**	**1.4**	**1.86**

S.No:	Text Books	Author	Publisher
1.	Airport Planning and Design	S.K. Khanna & M.G. Arora	S.K. Nem Chand & Bros., Roorkee
2	Dock and Harbour Engineering	H.P. Oza & G.H. Oza	Charotar Publishing House Pvt. Ltd., Anand
	References		
1.	Airport Engineering: Planning, Design and Development of 21st Century Airports	N.J. Ashford, Saleh Mumayiz & Paul H. Wright	John Wiley and Sons
2.	Planning and Design of Airports	Robert Horonjeff & Francis X McKelvey	Mc. Graw Hill
3.	Design and Construction of Ports and Marine Structures	Alonzo Def. Quinn	Mc. Gram Hill

Course Code	**BCIVDEG725**					
Category	**Professional Elective I**					
Course Title	**Engineering Geology**					
Scheme and Credits	**L**	**T**	**P**	**No. of Hrs./Week**	**Credits**	**Semester- 7 (Seventh)**
	3	**0**	**2**	**5**	**4**	
Pre requisites	**Engineering Chemistry**					

Course Learning Outcomes (CLOs)

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

i) CLO1: Understand the behavior of rocks at different scales, under loading conditions at the ground surface and in the subsurface.

ii) CLO2: Understand the link between rock mechanics, geology, and hydrogeology.

iii) CLO3: Understand the various engineering properties of Earth's materials.

iv) CLO4: Identify geologically significant places to learn the in-situ character of rocks in quarries, outcrops, road cuttings, dams, tunnels, and underground excavations.

v) CLO5: Analyse earthquake mechanisms and their effects on civil structures.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Physical Geology: Scope and importance of engineering geology in civil engineering; Internal structure of the earth; Weathering, erosion, and denudation processes; Geological work of wind, rivers, underground water, and glaciers. Occurrence and engineering significance of groundwater.
Module 2.	Mineralogy and Petrology Definition and classification of minerals; Physical and chemical properties of common rock-forming minerals; Formation processes and classification of igneous, sedimentary, and metamorphic rocks; Textural and structural characteristics; laboratory/field identification of rocks; Suitability of rocks and natural geological materials as construction and foundation materials.
Module 3.	Structural Geology: Outcrop; Stratification; Dip and strike relation; Unconformities: types, recognition methods and engineering relevance; Joints: types, causes and impacts on stability; Faults and folds: classification, mechanics of formation, recognition and significance; Remote sensing and GIS applications in engineering geology; Geological maps and map interpretation
Module 4.	Engineering Applications in Infrastructure Projects: Geological investigations: surface and subsurface investigations; Engineering geological considerations in site selection, feasibility, and design of dams, reservoirs, tunnels, highways, bridges, and underground excavations; Rock mass classification systems (RQD, RMR, and Q-System)
Module 5.	Geological Hazards and Disaster Risk Management: Earthquake mechanisms and seismicity; Seismic hazard assessment and microzonation; Liquefaction and ground failure; Geological hazards including landslides, subsidence, and coastal erosion; Geological aspects of climate change; Risk mitigation and resilience in civil engineering projects; Case studies of major engineering failures due to geological factors.

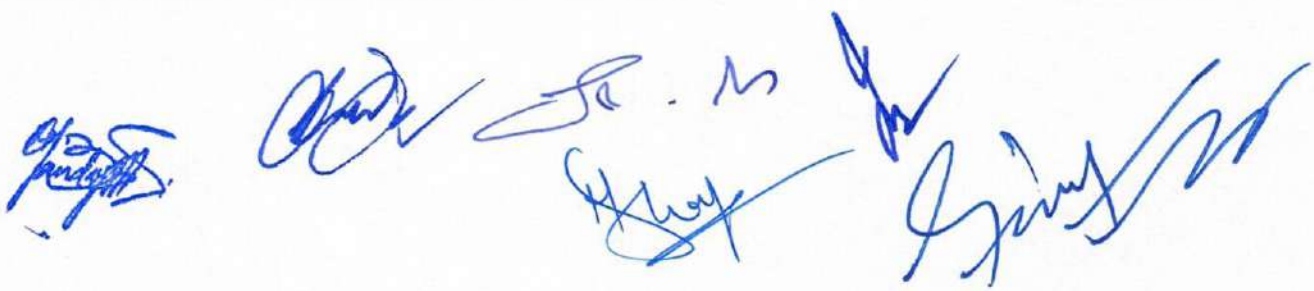
CLO-PLO Mapping Matrix													
CLO \ PLO	**PLO 1**	**PLO 2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PLO11**	**PLO12**	**Avg. CLO**

CLO1	3	2	0	1	0	2	0	0	1	0	2	2	1.1
CLO2	3	3	3	1	1	2	1	0	1	0	0	2	1.4
CLO3	3	2	2	3	3	2	1	0	2	2	1	3	2.0
CLO4	3	3	3	3	2	2	2	0	1	2	2	3	2.2
CLO5	3	3	3	3	2	3	2	0	1	2	2	3	2.3
Avg. PLO	3.0	2.6	2.2	2.2	1.6	2.2	1.2	0	1.2	1.2	1.4	2.6	1.8

S.No:	Text Books	Author	Publisher
1.	Principles of Engineering Geology,	Bangar, K.M.,	Standard Publishers Distributors, New Delhi.
2	Engineering Geology	Singh, P.,	Katson Publishers, New Delhi.
	References		
1.	Geology for Civil Engineers	Gribble, C. & McLean, A.,	(2nd Edition), CRC Press, Taylor & Francis Group, London

List of Experiments

1	Identification of common rock-forming minerals based on physical properties (colour, lustre, streak, hardness, cleavage, fracture, and specific gravity).
2	Identification and interpretation of geological structures (outcrop, dip, strike, joints, faults, folds, and unconformities) using models and hand specimens.
3	Determination of Rock Quality Designation (RQD) and introduction to Rock Mass Rating (RMR) using core samples/data.
4	Demonstration of the Point Load Strength Index Test on rocks.
5	Demonstration of the Uniaxial Compressive Strength (UCS) test on rock cores.



Course Code	BCIVDAC725					
Category	Programme Elective Course					
Course Title	Advanced Reinforced Concrete Structures					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	2	1	0	3	3	
Pre requisites	**Physics, Mathematics, Strength of Materials. Structural analysis, Analysis of Indeterminate Structures, Concrete Technology, Building Materials, Design of reinforced concrete structures.**					

Course Learning Outcomes (CLOs)

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

i) **CLO1:** Analysis and design of footings for reinforced concrete structures.

ii) **CLO2:** Analysis and design of retaining walls for unstable soil embankments.

iii) **CLO3:** Analysis and design of water tanks.

iv) **CLO4:** Analysis and design of Domes

v) **CLO5:** Analysis and design of Deep beams.

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Introduction to the footings, Various types of RCC footings, design considerations, design of RCC isolated and combined footings.
Module 2.	Introduction to retaining walls, types of retaining walls, stability requirements of retaining walls, design of cantilever and counter-fort retaining walls.
Module 3.	Introduction to liquid resting structures; types, Design considerations; Design of circular & rectangular water tanks resting on the ground and underground, with reference to IS:3370 (2009).
Module 4.	Analysis and design of spherical & conical domes by statical methods.
Module 5.	Deep Beams: General features, Parameters influencing design, Flexural bending and shear stresses in deep beams. Design provisions of IS-456, check for local failures, detailing of reinforcement in deep beams.

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	0	1.25
CLO2	3	3	3	3	0	1	1	1	0	0	0	0	1.25
CLO3	3	3	3	3	0	1	1	1	0	0	0	0	1.25
CLO4	3	3	3	3	0	1	1	1	0	0	0	0	1.25
CLO5	3	3	3	3	0	1	1	1	0	0	0	0	1.25
Avg PLO	3	3	3	3	0	1	1	1	0	0	0	0	1.25

S.No:	Text Books	Author	Publisher
1.	Reinforced Concrete Design	S Unnikrishna Pillai, Devdas Menon	McGraw Hill
2	Advanced R.C.Design	Krishna Raju	CBS
	References		
1.	Advanced Reinforced Concrete	P.C. Vargese	Prentice Hall

Course Code	BCIVDAN725					
Category	Programme Elective Course					
Course Title	Air and Noise Pollution Control Engineering					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	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: Understand the sources, effects, and control of air and noise pollution.

ii) CLO2: Explain air pollutant sampling, monitoring, and dispersion principles.

iii) CLO3: Apply air pollution control technologies for particulate and gaseous pollutants.

iv) CLO4: Analyze air quality and noise pollution problems using engineering principles.

v) CLO5: Select suitable pollution control methods to meet environmental standards.

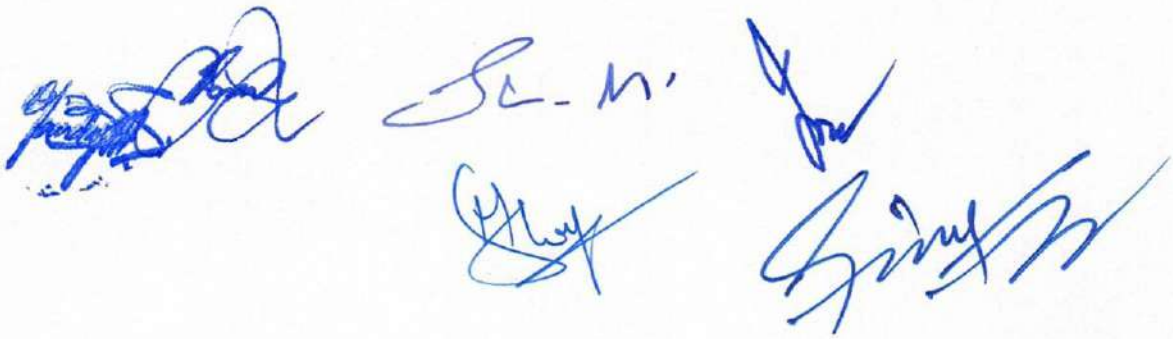
Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Composition and structure of atmosphere, Air pollutants, Sources and sinks, Classification of pollutant,, effect on human health vegetation and property, Reactions of pollutants and their effects, Smoke, smog and ozone layer disturbance, Greenhouse effect
Module 2.	Basic Principles of Sampling, Source and ambient sampling, Analysis of pollutants, Principles, Wind roses, Lapse rate, Atmospheric stability and turbulence, Plume rise, Dispersion of pollutants, Dispersion models, Emission Factors
Module 3.	Control strategies and policies, Choosing appropriate air pollution control technology, Particulate Pollutant Control, Settling chambers, Filtration, Electrostatic precipitation, Cyclone separation, Wet collectors
Module 4.	Gaseous Pollutant Control, Gas absorption in tray and packed towers, Absorption, Adsorption in fixed beds, Breakthrough. Control technologies for removal of SO2, NOx, VOC, Control technologies for motor vehicles
Module 5.	Noise Pollution, definition, sources, effects, measurement, standards and limit values, instrumentation and monitoring procedure, and control.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO 1	PLO 2	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	3	0	2	0	0	0	0	0	1.08
CLO3	3	2	3	2	2	0	3	0	0	0	0	0	1.25
CLO4	2	3	2	3	2	0	3	0	0	0	0	0	1.25
CLO5	2	3	2	2	2	0	3	0	0	0	0	0	1.17
Avg. PLO	2.60	2.60	1.40	1.80	1.80	0.00	2.80	0.00	0.00	0.00	0.00	0.00	1.008

S.No:	Text Books	Author	Publisher
1.	Environmental Pollution Control Engineering	Rao C.S	New Age International Ltd
2	Noise Pollution and Its Control	K.N.Rao and S.L.Patil	Daya Publishing House
	References		
1.	Air pollution control Engineering	Noel de Nevers	Waveland Press, INC
2.	Environmental Engineering	Peavy H.S., Rowe D.R., Tchobanoglous G	McGraw Hills
3.	Environmental Noise Pollution	Cunniff P.F	McGraw Hill



Course Code	BCIVDTP725					
Category	Programme Elective Course					
Course Title	Transportation Planning and Economics					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	3	0	0	3	3	
Pre requisites	Highway Engineering, Traffic Engineering, Project Management & Network Analysis, Basic Surveying					

Course Learning Outcomes (CLOs)

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

i) **CLO1:** Understand the fundamentals of transportation planning and economics

ii) **CLO2:** Compare public transportation systems and transit operations.

iii) **CLO3:** Interpret transportation planning models and demand forecasting techniques

iv) **CLO4:** Apply economic evaluation methods to highway projects

v) **CLO5:** Evaluate transportation investment alternatives using economic analysis techniques.

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Introduction: Scope of transportation planning and transportation economics, transportation planning issues.
Module 2.	Public Transportation: public transport modes, desirable characteristics of public transport systems, transit system operations, route development, stopping policy, stop location, scheduling, the capacity of transit systems, socially optimal pricing.
Module 3.	Transport analysis and forecasting: Transport planning process, transportation and land use, transport planning strategies, transport planning models, travel demand analysis, operational transportation, and land use, models.
Module 4.	Pavement Economics and Highway Cost Components: Pavement economics, construction cost; maintenance cost and vehicle operation cost, economic evaluation of highway projects- basic principles.
Module 5.	Transportation Economics : Time value of money; costs and benefits; net present value (NPV) method; benefit cost (B/C) ratio method; internal rate of return (IRR) method; comparison of evaluation techniques, freight transport-trends, and economic growth.

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	1	1	0	1	1.25
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	2	2	1	1.58
CLO5	3	3	3	2	2	2	3	1	2	2	2	2	2.25
Avg PLO	2.4	2.6	2.2	2	1.6	0.8	2	0.2	1	1.4	1	1.4	1.55

S.No:	Text Books	Author	Publisher
1.	Transport Planning and Traffic Engineering	CA O'Flaherty	Wiley & Sons, Inc., New York; Toronto.
	References		
1.	Principles of Transportation Engineering	Chakarborty & Das	Prentice-Hall of India

Course Code	BCIVDGI725					
Category	Programme Elective Course					
Course Title	Ground Improvement Techniques					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	3	0	0	3	3	
Pre requisites	Soil Mechanics and Foundation Engineering					

Course Learning Outcomes (CLOs)

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

i) CLO1: Identify problematic soil conditions and explain the need, objectives, and selection criteria for appropriate ground improvement techniques.

ii) CLO2: Analyze and apply mechanical ground improvement methods such as compaction and densification based on soil type and field requirements.

iii) CLO3: Evaluate hydraulic ground improvement techniques, including dewatering, drainage, preloading, and vertical drains for different geotechnical applications.

iv) CLO4: Understand the effects of chemical stabilization and grouting methods on engineering properties of soils for foundations, embankments, and pavements.

v) CLO5: Interpret practical case studies and field applications to select suitable ground improvement solutions for real-world engineering problems.

Theory Module (Internal and External Evaluation)

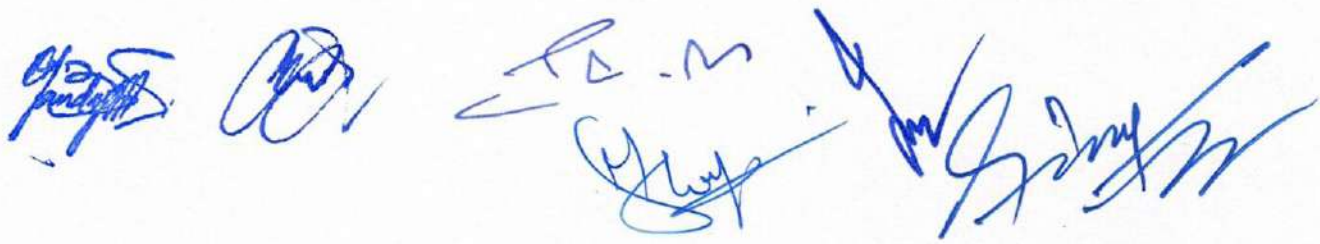
M.No:	Topic
Module 1.	Problematic ground conditions; Soil investigation and classification relevant to ground improvement; Need and objectives of engineered ground improvement; Classification of ground improvement techniques; Selection criteria based on suitability, feasibility, and desirability; Overview of current practices and future developments in ground improvement.
Module 2.	Mechanical methods of ground improvement; Principles of soil densification and compaction; Methods of compaction control and quality assurance; Compaction specifications and field requirements; Types, selection, and performance of compaction equipment.
Module 3.	Hydraulic methods of ground improvement; Objectives and techniques of dewatering; Soil-water interaction; Single-well and multi-well dewatering systems; Slope drainage systems; Filtration and seepage control; Preloading techniques with vertical drains; Electrokinetic dewatering and stabilization.
Module 4.	Chemical stabilization of soils; Effects of stabilizing agents such as cement, lime, fly ash, bitumen, and cement–lime–fly ash mixtures on engineering properties of soils; Use of chemical additives including NaCl, $CaCl_2$, $CaSO_4$, $Ca(OH)_2$, and NaOH; Grouting techniques and applications to embankments, foundations, and sensitive soils; Role of admixtures in pavement engineering; Bio-Enzyme Stabilization
Module 5.	Thermal methods of ground improvement; Thermal properties of soils; Heat treatment and ground freezing techniques; Strength and deformation behavior of frozen ground; Ground improvement using inclusions and confinement; Principles and evolution of soil reinforcement; Applications of geosynthetics; Soil nailing and ground anchoring systems.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg. CLO
CLO1	3	3	3	2	1	1	1	0	1	1	3	3	1.8
CLO2	3	3	3	2	2	1	0	0	1	1	3	3	1.8

CLO3	3	3	3	2	2	1	0	0	2	1	3	3	1.9
CLO4	3	3	3	2	2	1	0	0	2	1	3	3	1.9
CLO5	3	3	3	2	3	1	0	0	1	1	3	3	1.9
Avg. PLO	3.0	3.0	3.0	2.0	2.0	1.0	0.2	0.0	1.4	1.0	3.0	3.0	1.9

S.No:	Text Books	Author	Publisher
1.	Ground Improvement	Moseley, M.P. and Kirsch, K.,	2nd Edition, CRC Press / Taylor & Francis
2	Engineering Principles of Ground Modification	Hausmann, M.R.,	McGraw-Hill.
	References		
1.	Principles of Foundation Engineering	Braja M. Das,	Cengage Learning.
2.	Principles and Practice of Ground Improvement	Han, J.	John Wiley & Sons.
3.	Soil Improvement and Ground Modification Methods	Nicholson, P.G.,	Butterworth-Heinemann.



Course Code	BCIVPPW725					
Category	Lab Course					
Course Title	Project Pre Work					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 7 (Seventh)
	0	0	8	4	4	
Pre requisites	Fundamental Knowledge of Civil Engineering					

Course Outcomes (COs) Upon successful completion of this course, the students will be able to:

CLO1: Identify and define a research problem through literature review and industrial interaction.

CLO2: Develop a project methodology for the proposed investigation, including the design of experiments.

CLO3: Evaluate and select appropriate analytical, experimental, computational, or field-based methods for the proposed project.

CLO4: Assess the technical feasibility and expected outcomes of the proposed project.

CLO5: Prepare and present the project proposal through technical reports and presentations

Description:

The project pre-work is an essential component of the B.Tech. program, where students apply the knowledge and skills acquired during their studies to identify real-world engineering problems. The students develop methodologies to solve these problems by applying appropriate analytical, experimental, computational, or field-based methods.

Course Plan:

Projects will be undertaken in groups that will nurture the concept of teamwork. Assessment will be by means of a presentation, submission of a report, and a demonstration of work undertaken. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres. Each group of students shall identify a topic(s) from the civil engineering discipline or interdisciplinary type, approved by the Project and Training Incharge (PTI), and eventually it will be assessed later before an expert committee constituted by the concerned department on the basis of the following:

- Quality of content presented.
- Proper planning for a presentation.
- Effectiveness of presentation.
- Report writing based on the state of the art, fundamentals of the topic and its viability.

CLO-PLO Mapping Matrix													
CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	3	1	3	2	2	2	1	2	2	1	2	**2**
CLO2	2	3	2	3	2	1	2	2	2	1	3	2	**2.08**
CLO3	3	3	2	3	3	1	2	3	2	1	2	2	**2.25**
CLO4	2	3	3	3	2	3	3	2	1	1	3	2	**2.33**
CLO5	1	1	1	1	2	1	1	2	3	3	3	3	**1.83**
Avg PLO	**2.2**	**2.6**	**1.8**	**2.6**	**2.2**	**1.6**	**2**	**2**	**2**	**1.6**	**2.4**	**2.2**	**2.1**

Course Code	**BCIVDER825**					
Category	**Programme Elective Course**					
Course Title	**Earthquake Resistant Design**					
Scheme and Credits	**L**	**T**	**P**	**No. of Hrs./Week**	**Credits**	**Semester- 8 (Eighth)**
	2	1	0	3	3	
Pre-requisites	**Strength of Materials, Structural Dynamics**					

Course Learning Outcomes (CLOs)

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

***i*) CLO1:** Explain earthquake phenomena, seismic hazards, and ground motion characteristics.

ii) CLO2: Apply structural dynamics principles to determine seismic response.

iii) CLO3: Analyse structures using IS 1893 (Part 1): 2016 provisions and seismic analysis methods.

iv) CLO4: Design and detail earthquake-resistant RC members as per IS 13920:2016.

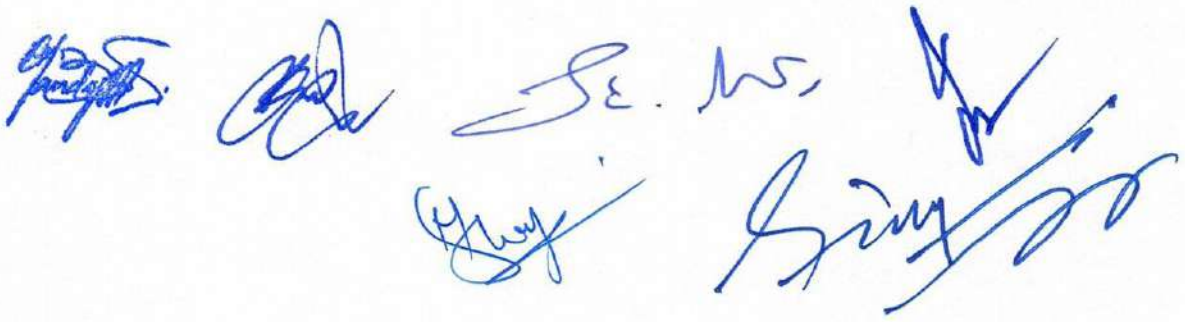
v) CLO5: Evaluate retrofitting strategies, performance-based design concepts, and seismic analysis software applications.

Theory Module (Internal and External Evaluation)

M. No.:	Topic
Module 1.	Introduction to earthquakes, Basic Terminology, Causes of Earthquakes, Magnitude & intensity, Ground Motion Parameters, Response Spectra, Design Spectra, Past Earthquakes and lessons learned
Module 2.	Theory of Vibrations, Free and Forced Vibrations, Undamped and Damped Vibration, Logarithmic Decrement, Deterministic Analysis, Lateral forces, Application of Green's Theorem in Earthquake Engineering.
Module 3.	Overview of IS 1893 (Part 1): 2016. General Provisions and Building Configuration. Load Combinations. Seismic Weight and Distribution of Seismic Forces. Analysis Methods (Equivalent Static Method, Response Spectrum Method). Torsion in Buildings and Methods to Counteract. Introduction to Seismic Design of Masonry Structures.
Module 4.	Overview of IS 13920: 2016. Importance of Ductility in Seismic Design. Detailing Requirements for Beams, Columns, and Joints. Detailing Requirements for Shear Walls and Frame-Shear Wall Systems.
Module 5.	Seismic Retrofitting, Introduction to Advanced Topics in Seismic Design. Performance-Based Seismic Design. Nonlinear Static and Dynamic Analysis (Pushover Analysis). Introduction to Seismic Analysis and Design Software.

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	1	0	0	0	0	0	1	**0.58**
CLO2	3	3	2	2	1	0	0	0	0	0	0	1	**1**
CLO3	3	3	3	2	2	0	0	0	0	0	0	1	**1.17**
CLO4	3	3	3	1	1	2	0	1	0	0	0	2	**1.33**
CLO5	2	3	3	3	3	2	1	1	0	1	0	3	**1.83**
Avg PLO	**2.8**	**2.8**	**2.2**	**1.6**	**1.4**	**1**	**0.2**	**0.4**	**0**	**0.2**	**0**	**1.6**	**1.18**

S.No:	Text Books	Author	Publisher
1.	Earthquake-Resistant Design of Building Structures	Duggal, S. K.	Oxford University Press.
	References		
1.	Dynamics of Structures: Theory and Applications to Earthquake Engineering	Chopra, A. K.	Pearson Education
2.	Earthquake Resistant Design of Structures	Agarwal, Pankaj & Shrikhande, Manish	Prentice Hall of India (PHI)
3.	Fundamentals of Earthquake Engineering	Elnashai, A. S. & Di Sarno, L.	John Wiley & Sons
4.	IS 1893 (Part 1): 2016 – Criteria for Earthquake Resistant Design of Structures	IS Code	BIS, New Delhi
5.	IS 13920: 2016 – Ductile Design and Detailing of Reinforced Concrete Structures Subjected to Seismic Forces	IS Code	BIS, New Delhi
6.	IS 4326: 2013 – Earthquake Resistant Design and Construction of Buildings	IS Code	BIS, New Delhi



Course Code	BCIVDHW825					
Category	Programme Elective Course					
Course Title	Hazardous Waste Management					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 8 (Eighth)
	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: Understand hazardous waste concepts, classification, and regulations.

ii) CLO2: Compare hazardous waste management and treatment methods.

iii) CLO3: Interpret contaminant behavior, risks, and remediation approaches.

iv) CLO4: Illustrate hazardous waste treatment, disposal, and remediation processes.

v) CLO5: Develop an integrated hazardous waste management and contaminated site remediation plan.

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Hazardous Waste Fundamentals: Definition, landmark episodes, classification, generation, Basel Convention, U.S. regulatory framework (RCRA and CERCLA/Superfund), Hazardous and Other Wastes (Management and Transboundary Movement) Rules 2016, physiochemical properties (partition coefficients, octanol-water, soil-water, organic-carbon, bioconcentration factor)
Module 2.	Fate and Transport of Contaminants: Contaminant release in air, soil, and water; transport mechanisms (advection, dispersion, diffusion); non-ideal contaminant transport; contaminant fate in the subsurface (retardation, attenuation, mobility enhancement). Toxicology: Definition; exposure (absorption mechanisms, distribution and storage, biotransformation, elimination, pharmacokinetics, exposure duration); toxic effects (structural affinity, classification of toxic actions and effects); dose–response relationships; non-carcinogens (threshold, NOAEL, ADI, RfD, risk calculation); carcinogens (classification and dose–response relationships).
Module 3.	Current Management Practices: Environmental audit (types, features of effective environmental audit, program planning, preaudit preparation, on-site activities, evaluation and presentation; Pollution prevention (management strategies, volume reduction methods, toxicity reduction methods, recycling); Facility types, operations and site selection.
Module 4.	Treatment and Disposal Methods: Physicochemical processes (air stripping, carbon adsorption, steam stripping, chemical oxidation, membrane processes); Biological processes (treatment of liquids, slurry phase treatment, solid and vapor phase treatment, monitored natural attenuation, enhanced degradation).
Module 5.	Remediation of Contaminated Sites: Quantitative risk assessment (risk and hazard definition, purpose of risk assessment, hazard identification, exposure assessment, toxicity assessment, risk characterization, risk communication); Methods of site characterization (geophysical methods, boring and sampling, monitoring wells); Remedial technologies.

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	3	0	0	0	0	0	1.25
CLO3	2	3	2	3	2	0	3	0	0	0	0	0	1.25
CLO4	3	2	3	2	2	0	3	0	0	0	0	0	1.25
CLO5	2	3	3	2	2	0	3	0	0	2	2	0	1.58
Avg. PLO	2.60	2.60	2.00	1.80	1.60	0.00	3.00	0.00	0.00	0.40	0.40	0.00	1.2

S.No:	Text Books	Author	Publisher
1.	Hazardous Waste Management	LaGrega, M.D., Buckingham, P.L. and Evans, J.C.,	McGRAW-HILL
	References		
1.	Standard Handbook of Hazardous Waste Treatment and Disposal	Freeman, H.W.	McGraw Hill

Course Code	BCIVDUT825					
Category	Programme Elective Course					
Course Title	Urban Transportation Planning					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 8 (Eighth)
	3	0	0	3	3	
Pre requisites	Highway Engineering, Traffic Engineering & Road Facilities, Surveying					

Course Learning Outcomes (CLOs)

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

i) CLO1: Understand the fundamentals of transportation systems and socio-economic activities

ii) CLO2: Analyze urban transportation planning processes and transport models

iii) CLO3: Evaluate transportation survey data for travel demand analysis.

iv) CLO4: Apply urban structure concepts to transportation planning

v) CLO5: Develop urban goods movement strategies using transportation planning principles

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Introduction: Transport and Socioeconomic Activities; Historical Development of Transport; Transportation in the Cities; Freight Transportation; Future Developments.
Module 2.	Urban Transportation System Planning Conceptual Aspects: Transport Planning Process, Problem Definition, Solution Generation, Solution Analysis, Evaluation and Choice, Implementation, Sequence of Activities Involved in Transport Analysis. Trip generation, trip distribution , mode choice, traffic assignment, Transport system models
Module 3.	Transportation Survey: Definition of Study Area, Zoning, Types of Movements,Types of Surveys, Home-Interview Survey, Commercial Vehicle Survey, Intermediate Public Transport Survey, Cordon-Line Survey, Post-Card Questionnaire Survey, Registration-Number Survey, Tag-on-Vehicle Survey.
Module 4.	Urban Structure: Urban Activity Systems, Urban Movement Hierarchies, Types of Urban Structure, Centripetal - Type Urban Structure, Grid-Type Urban Structure, Linear-Type Urban Structure, Directional Grid Urban Structure
Module 5.	Urban Goods Movement: Classification of Urban Goods Movements. Methodology of Approach to Analysis of Goods Movement. Modelling Demand for Urban Goods Transport.

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	2	2	1	0	1	0	1	1.17
CLO2	2	3	3	2	2	1	2	0	1	1	1	2	1.67
CLO3	2	3	2	3	3	1	2	0	2	2	1	2	1.92
CLO4	2	2	3	2	2	1	3	0	1	2	0	2	1.67
CLO5	3	3	3	3	2	2	3	1	2	2	2	2	2.33

Avg PLO	2.4	2.6	2.4	2.2	1.8	1.4	2.4	0.4	1.2	1.6	0.8	1.8	1.75

S.No:	Text Books	Author	Publisher
1.	Principles of Urban Transport Systems Planning	Hutchinson,B.G.,	McGraw Hill Book Company
	References		
1.	Traffic Engineering and Transport Planning	Kadiyali, L.R.,	Khanna Publishers, New Delhi

Course Code	BCIVDSS825					
Category	Programme Elective Course					
Course Title	Soil Structure Interaction					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 8 (Eighth)
	2	1	0	3	3	
Pre requisites	Soil Mechanics					

Course Learning Outcomes (CLOs)

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

***i*) CLO1:** Explain the fundamentals of soil–structure interaction and dynamic loading.

ii) CLO2: Apply elastic foundation models to analyse soil–foundation interaction.

iii) CLO3: Analyse beams and foundations on elastic media.

iv) CLO4: Evaluate the response of pile foundations under vertical and lateral loading.

v) CLO5: Interpret numerical modelling approaches and engineering applications of soil–structure interaction.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Importance of Soil–Structure Interaction, Foundation and Soil–Foundation Interface Behaviour, Dynamic Loading, Limiting Movements, Criteria for Design under Dynamic Loading.
Module 2.	Elastic Models of Soil Behaviour, Winkler Model, Isotropic Elastic Continuum Model, Two-Parameter Elastic Models, Pasternak Model, Filonenko-Borodich Model, Time-Dependent Behaviour of Soils.
Module 3.	Soil–Foundation Interaction Models, Bernoulli–Euler Beam Theory, Infinite and Finite Beams, Beams Resting on Winkler and Pasternak Foundations.
Module 4.	Soil–Pile Interaction, Long and Short Piles, Elastic Analysis of Single Piles, Settlement and Load Distribution, Laterally Loaded Piles, Elastic Solutions, Broms' Method.
Module 5.	Introduction to Numerical Modelling of Soil–Structure Interaction, Computational Approaches, Interpretation of Numerical Results, and Engineering Applications.

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	1	**0.5**
CLO2	3	3	2	2	2	0	0	0	0	0	0	0	**1**
CLO3	3	3	3	3	2	0	0	0	0	0	0	0	**1.17**
CLO4	3	3	3	3	2	0	0	0	0	0	2	0	**1.33**
CLO5	2	3	3	3	3	0	0	0	0	0	2	2	**1.5**

Avg PLO	**2.8**	**2.8**	**2.2**	**2.2**	**1.8**	**0**	**0**	**0**	**0**	**0**	**0.8**	**0.6**	**1.10**

S.No:	Text Books	Author	Publisher
1.	Foundation Analysis and Design	Bowles, J. E.	McGraw-Hill
References			
1.	Elastic Analysis of Soil–Foundation Interaction	Selvadurai, A. P. S.	Elsevier
2.	Soil–Structure Interaction Analysis in Time Domain	Wolf, J. P.	Prentice Hall

Course Code	BCIVORS825					
Category	Open Elective Course					
Course Title	Remote Sensing and GIS Applications in Engineering					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 8 (Eighth)
	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 remote sensing, electromagnetic radiation, and data acquisition systems.

ii) **CLO2:** Describe remote sensing platforms, sensor types, and characteristics of remotely sensed data.

iii) **CLO3:** Apply image interpretation and digital image processing techniques for classification and thematic mapping.

iv) **CLO4:** Analyze GIS concepts, spatial data models, and perform spatial data integration and analysis.

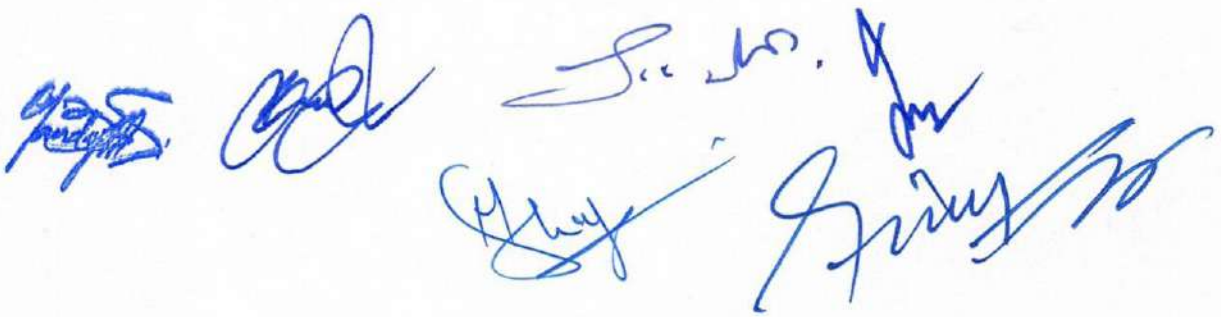
v) **CLO5:** Evaluate the application of remote sensing and GIS in areas such as land use planning, water resources, disaster management, and infrastructure development.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Fundamental concepts of remote sensing; historical development; scope and significance in engineering applications; components of a remote sensing system; energy sources; electromagnetic radiation; interaction with Earth's surface and atmosphere.
Module 2.	Types of remote sensing platforms: ground-based, airborne, and satellite; principles of active and passive sensors; applications; characteristics of remotely sensed data including spatial, spectral, radiometric, and temporal resolutions.
Module 3.	Fundamentals of visual image interpretation (tone, texture, size, shape, pattern, shadow, and association); digital image processing techniques (preprocessing, enhancement, filtering, and transformation); classification techniques (supervised and unsupervised); accuracy assessment; thematic map generation
Module 4.	GIS concepts; components, functions, and advantages; spatial and attribute data; GIS data models (raster and vector); map projections; coordinate systems; georeferencing; spatial data integration and analysis in engineering applications.
Module 5.	Applications in land use and land cover mapping, urban and regional planning, transportation network analysis, water resources and watershed management, environmental impact assessment, disaster management (flood and earthquake studies), infrastructure planning and monitoring for sustainable development

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	1	0	0	0	0	0	0.50
CLO2	3	2	0	0	2	0	1	0	0	0	0	0	0.67
CLO3	2	3	2	3	3	0	2	0	0	0	0	0	1.25
CLO4	2	3	2	3	3	0	2	0	0	0	1	0	1.33
CLO5	2	3	3	2	3	2	3	1	2	2	1	1	2.08
Avg PLO	2.4	2.6	1.4	1.6	2.2	0.4	1.8	0.2	0.4	0.4	0.4	0.2	1.16

S.No:	Text Books	Author	Publisher
1.	Remote Sensing and GIS	Basudeb Bhatta	Oxford University Press
	References		
1.	Remote Sensing and GIS: Principles, Techniques, and Uses	Apperdeep Kaur and Yugendra Devidas Chincholkar	Addition Publishing House



Course Code	BCIVORM725					
Category	Open Elective Course					
Course Title	Research Methodology					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 8 (Eighth)
	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 fundamentals of research methodology, types of research, and problem formulation.

ii) **CLO2:** Conduct literature survey and evaluate research quality using impact factor, citations, and indices.

iii) **CLO3:** Apply data collection methods, sampling techniques, and statistical tools for data analysis and hypothesis testing.

iv) **CLO4:** Prepare technical documents including research papers, reports, and presentations using proper referencing styles.

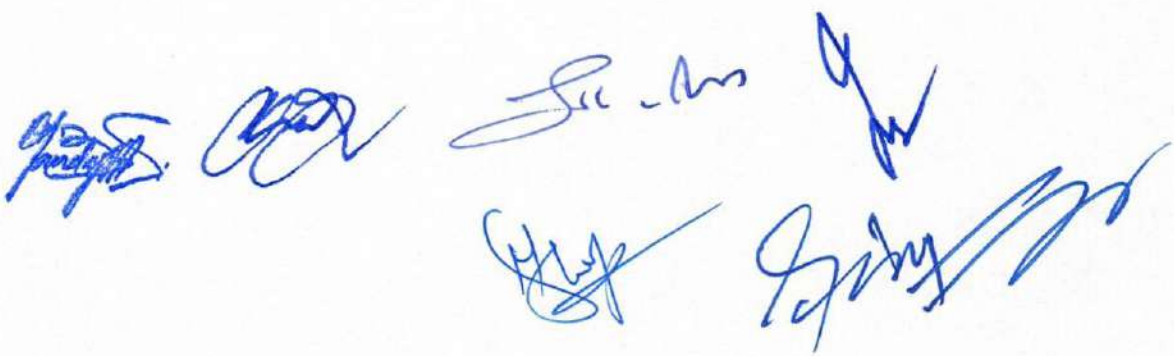
v) **CLO5:** Demonstrate understanding of intellectual property rights, ethics, and plagiarism in research.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Introduction to Research: Meaning, objective, and importance of research, types of research, steps involved in research, defining research problem
Module 2.	Literature Survey: Overview of literature survey, Literature survey using various journals, Various factors like Impact factor, citation, H-Index
Module 3.	Data Collection: Classification of Data, Methods of Data Collection, Sampling, Sampling techniques, Procedure and Methods, Ethical considerations in research. Data analysis, statistical techniques, hypothesis, hypothesis testing, data processing software (SPSS), statistical inference, interpretation of results.
Module 4.	Technical Writing, Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation, Referencing and referencing styles, Research Journals, Indexing and citation of Journals,
Module 5.	Intellectual property, Intellectual Property Rights, Introduction to Patent, Copyright, trademark, Trade Secret, Plagiarism

CLO-PLO Mapping Matrix													
CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	2	2	2	0	1	0	0	0	0	0	0	0	2
CLO2	2	2	3	0	2	2	0	0	0	0	0	0	2
CLO3	2	2	3	2	3	2	0	0	0	0	0	1	2
CLO4	1	1	2	2	1	2	0	0	0	2	3	1	2
CLO5	1	1	1	0	0	0	2	0	3	0	1	0	2
Avg PLO	1.6	1.6	2.2	0.8	1.4	1.2	0.4	0	0.6	0.4	0.8	0.4	2.0

S.No:	Text Books	Author	Publisher
1.	Research Methodology: A Step-by-Step Guide for Beginners	Ranjit Kumar	2nd Edition,
	References		
1.	Research Methodology Methods and Techniques	R. Kothari, Gaurav Garg	New age International Publishers



Course Code	BCIVOSC825					
Category	Open Elective Course					
Course Title	Smart Cities					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 8 (Eighth)
	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, components, policies, and challenges of smart cities and their development.

ii) **CLO2:** Analyze infrastructure systems, asset management, and sustainable planning approaches in smart cities.

iii) **CLO3:** Apply principles of smart construction, green buildings, and energy-efficient systems in urban development.

iv) **CLO4:** Evaluate smart transportation systems including ITS, traffic management, and mobility solutions.

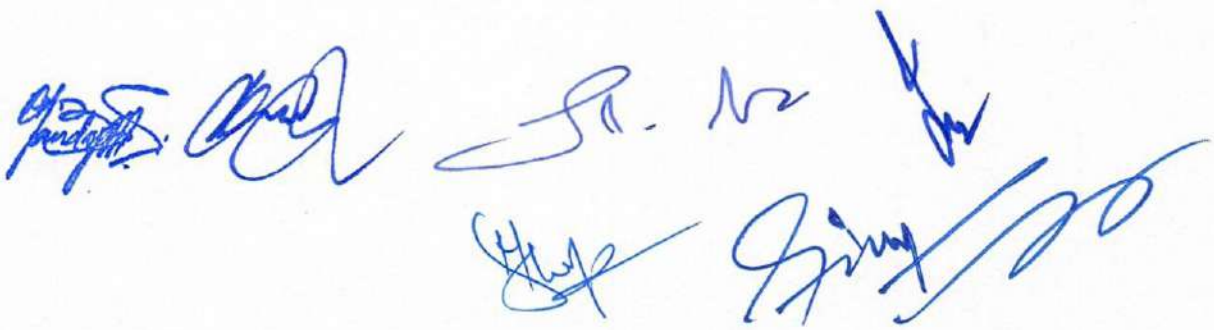
v) **CLO5:** Propose sustainable solutions for water supply, sanitation, flood management, and urban services in smart cities.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Definition, concept, need and importance, benefits of smart cities, history of smart city in India, features, components of a smart city, characteristics and factors of smart cities, smart structures, classification of smart structures, challenges faced in developing smart cities, scope of smart cities, worldwide policies for smart cities, Government of India: India "100 Smart Cities" Policy and Mission, smart cities in India, case studies of smart cities.
Module 2.	Infrastructure management in India, challenges, objectives, various types of infrastructure services, asset management and lifecycle assessment of infrastructure, Resilient and sustainable infrastructure planning, Infrastructure financing and cost optimisation, predictive and preventive maintenance systems
Module 3.	Dimensions of smart cities, smart construction, planning and design, theory and principles, sustainable building – housing, introduction to green buildings, features of green building rating systems in India: LEED, GRIHA, energy-saving systems, solar energy for smart city, project management.
Module 4.	Smart transportation systems; intelligent transportation systems (ITS); smart roads, traffic management systems, public transport integration, electric mobility, GIS and GPS applications, traffic safety management, parking management.
Module 5.	Storage and conveyance system of water; sustainable water and sanitation; sewerage system; flood management; conservation system methods

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	3	3	0	0	0	0	0	0.92
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	3	3	2	3	2	2	0	2	1	1	0	1.75
CLO5	2	3	3	2	2	3	3	0	2	1	1	1	1.92
Avg PLO	2.4	2.8	2.2	1.6	1.8	2.4	2.8	0	0.8	0.4	0.8	0.2	1.51

S.No:	Text Books	Author	Publisher
1.	A city for all: valuing differences and working with diversity	Joel Beall	Zed Books Limited, London (ISBN: 1-85649-477-2).
2	Insights into Inclusive Growth, Employment and Wellbeing in India	Arup Mitra	Springer (2013), New Delhi (ISBN: 978-81-322-0655-2)
	References		
1.	Urban Planning and Cultural Identity	William J. Neill	Routledge, London (ISBN: 0-415-19747-3



Course Code	**BCIVODB825**					
Category	**Programme Elective Course**					
Course Title	**Design of Bridge**					
Scheme and Credits	**L**	**T**	**P**	**No. of Hrs./Week**	**Credits**	**Semester- 8 (Eighth)**
	2	1	0	3	3	
Pre requisites	**Strength of Materials, Structural Analysis, Design of Reinforced Concrete Structures, Steel Structures, Geotechnical Engineering, Hydrology, Fluid Mechanics, Transportation Engineering**					

Course Learning Outcomes (CLOs)

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

***i*) CLO1:** Explain types, components, loading standards (IRC), and hydraulic aspects of bridges.

ii) CLO2: Analyse and design RCC culverts using codal provisions

iii) CLO3: Analyse and design RCC bridge deck slabs using IRC specifications.

iv) CLO4: Design steel plate girder bridges and understand composite bridge concepts.

v) CLO5: Analyse and design steel truss bridges under standard IRC loadings.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Introduction to bridges and classification of bridges; history and development of bridges; components of bridges; various types of loads acting on bridges; standard loadings for highway bridges as per IRC provisions; introduction to hydraulic design of bridges; concepts of scour depth, afflux, and stream flow (discharge measurements); introduction to bridge substructure and types of loads acting on substructure components.
Module 2.	Introduction to culverts; classification and types of culverts; components of culverts; design principles of RCC culverts; design of RCC solid slab culverts.
Module 3.	Analysis and design of RCC bridge deck slabs; effective width of slab; design considerations as per IRC specifications; Courbon's method for analysis of bridge deck slabs.
Module 4.	Introduction to plate girder bridges; analysis and design of steel plate girder bridges; design considerations for main girders and cross girders; introduction to composite bridges and their advantages.
Module 5.	Various forms of steel truss bridges; components of truss bridges; analysis and design of steel truss bridges based on standard IRC loadings; design of stringers and cross girders for single-lane and multi-lane bridges under IRC loading.

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	1	0	0	0	0	0	0.67
CLO2	3	3	3	2	2	0	1	0	0	0	1	0	1.25
CLO3	2	3	2	3	2	0	1	0	0	0	0	0	1.08
CLO4	3	3	3	2	2	0	1	0	0	0	1	0	1.25
CLO5	3	3	3	2	2	0	1	0	2	1	1	1	1.58
Avg PLO	2.8	2.8	2.2	1.8	1.6	0.4	1.0	0	0.4	0.2	0.6	0.2	1.16

S.No:	Text Books	Author	Publisher
1.	Design of Bridges	Krishna Raju, N	Oxford & IBH Publishing Co., New Delhi
	References		
1.	Design of Bridge Structures	T.R. JAGADEESH	PHI Learning Pvt.Ltd

Course Code	BCIVDSW825					
Category	Programme Elective Course					
Course Title	Solid Waste Management					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 8 (Seventh)
	3	0	0	3	3	
Pre requisites	Environmental Engineering					

Course Learning Outcomes (CLOs)

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

i) CLO1: Understand the sources, characteristics, and composition of municipal solid waste

ii) CLO2: Compare the physical, chemical, and biological properties of municipal solid waste.

iii) CLO3: Interpret solid waste generation, collection, and material recovery practices

iv) CLO4: Apply waste handling, separation, and storage techniques for municipal solid waste management.

v) CLO5: Develop suitable processing and disposal strategies for municipal solid waste.

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Sources and Composition of Municipal Solid Waste: Sources of solid waste. Types of solid waste. Characteristics of Solid waste, composition of solid waste and its determination.
Module 2.	Properties of Municipal Solid Waste :Physical properties of Municipal Solid Waste, Chemical properties of Municipal Solid Waste, Biological properties of Municipal Solid Waste and Transformation of Municipal Solid Waste.
Module 3.	Solid Waste Generation and Collection: Quantities of Solid Waste, Measurements, and methods to measure solid waste quantities. Solid waste generation and collection, Factors affecting solid waste generation rate, Quantities of materials recovered from MSW.
Module 4.	Handling, Separation, and Storage of Solid Waste: Handling and separation of solid waste at site. Material separation by pick in, screens, float and separator magnets, and electromechanical separator, and other latest devices for material separation. Waste handling and separation at Commercial and industrial facilities. Storage of solid waste at the sources.
Module 5.	Processing and disposal of Solid Waste: Processing of solid waste at residence e.g. Storage, conveying, compacting, shredding, pulping, granulating etc. Combustion and energy recovery of municipal solid waste, effects of combustion, undesirable effects of Combustion, Landfill: Classification, planning, sitting, permitting, landfill processes, landfill design, landfill operation.

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	2	3	1	0	0	0	1	1.17
CLO2	2	3	2	2	1	2	3	1	0	1	0	1	1.50
CLO3	2	3	2	3	2	2	3	0	1	2	1	2	1.92
CLO4	2	2	3	2	3	2	3	0	1	2	1	1	1.83
CLO5	3	3	3	3	3	2	3	1	2	2	2	2	2.42
Avg PLO	2.4	2.6	2.2	2.2	1.8	2	3	0.6	0.8	1.4	0.8	1.4	1.77

S.No:	Text Books	Author	Publisher
1.	Solid Waste Technology & Management	Christensen, H. T.	Wiley, 2010, Volume 1 & 2.
	References		
1.	Integrated Solid Waste Management: Engineering Principles and Management Issues	Tchobanoglous, G., Theisen and Vigil,	McGraw Hill

Course Code	BCIVDIT825					
Category	Programme Elective Course					
Course Title	Intelligent Transportation System					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 8 (Eighth)
	3	0	0	3	3	
Pre requisites	Traffic Engineering					

Course Learning Outcomes (CLOs)

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

***i)* CLO1:** Identify the multiple components of Intelligent Transportation Systems (ITS), including user services and support technologies.

***ii)* CLO2:** Understand the importance of ITS and its practical applications in improving transportation efficiency, proposing recommendations for appropriate ITS technologies corresponding to real traffic problems.

***iii)* CLO3:** Analyze advanced sensor data, gather extensive information, roadway, and traffic data, and estimate traffic congestion levels.

***iv)* CLO4:** Implement and execute suitable Intelligent Transportation Systems (ITS) and services to optimize transportation effectiveness by utilizing various ITS-based design and control elements.

***v)* CLO5:** Summarize about ITS issues in terms of various factors and emerging issues

Theory Module (Internal and External Evaluation)

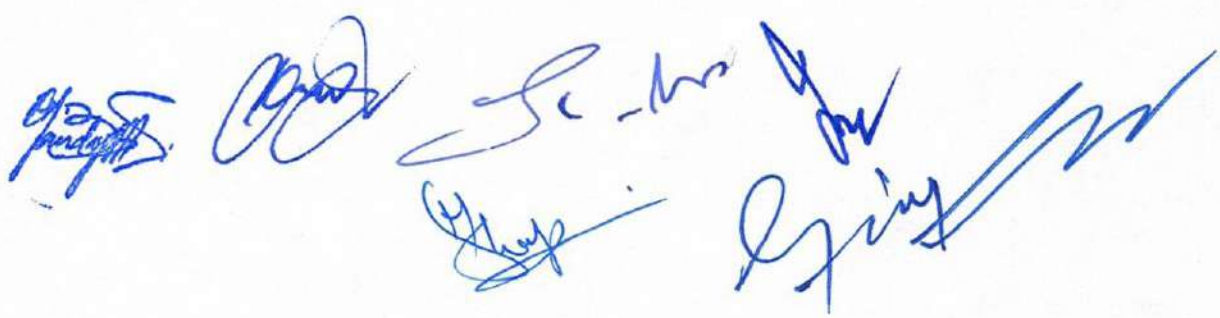
M.No:	Topic
Module 1.	Intelligent Transportation Systems (ITS) (History and Applications: Introduction to Intelligent Transportation Systems (ITS) – Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS - ITS Data collection techniques, Introduction to Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS) and application overview
Module 2.	ITS Functional Areas: Advanced Traveler Information Systems (ATIS) Trip Planner and its impact, Traffic density measurement, Variable message signs, Parking guidance, Weather information and variable speed limits, Impacts of ATIS
Module 3.	Telecommunications in ITS: The importance of telecommunications in the ITS system, information management, and traffic management center (TMC). Vehicle – Roadside communication – Vehicle Positioning System. Security CCTV systems, Wireless Sensor Networks and RFID, Blue-tooth and Wi-Fi sensors, inductive loop detectors and image processing techniques, Impacts of AVMS
Module 4.	ITS-based Design and Control Element: Advanced Traffic Management Systems (ATMS), Advanced Traveler Information Systems (ATIS), Commercial Vehicle Operations (CVO), Advanced Vehicle Control Systems (AVCS), Advanced Public Transportation Systems (APTS), Advanced Rural Transportation Systems (ARTS), Communication tools Dedicated

	Short-Range Communication (DSRC), Communications Access for Land Mobiles (CALM), traveler information tools, data handling, processing, and management TCM, and it's working
Module 5.	ITS Standards: ITS standards, development process, legal issues, financial issues, Mainstream ITS, integration and up-gradation, Future of ITS, case studies. ITS Programs in the World – Overview of ITS implementations in developed countries, ITS in developing countries.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO 5	PLO 6	PLO 7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg. CLO
CLO 1	3	0	0	0	2	0	0	0	0	0	0	3	0.66
CLO 2	2	3	0	2	0	0	0	0	0	0	0	2	0.75
CLO 3	2	2	0	3	3	0	0	0	0	2	0	0	1.0
CLO 4	3	2	3	0	3	3	0	0	0	0	0	2	1.3
CLO 5	2	0	0	0	0	2	2	2	1	0	3	3	1.25
Avg. PLO	2.4	1.40	0.60	1.00	1.6	1.0	0.40	0.40	0.2	0.40	0.6	2	1

S.No:	Text Books	Author	Publisher
1.	Fundamentals of Intelligent Transportation Systems Planning	M.A. Chowdhury and A. Sadek	Artech House Publishers. , 2003 publications or the latest
2	Intelligent Transportation Systems: New Principles and Architectures"	Ghosh, S., Lee, T.S	CRC Press, 2000.
	References		
1.	Perspectives on Intelligent Transportation Systems	Sussman, J.M	Springer, Berlin, 2010.
2.	Traffic Engineering	R.P Roess, E.S. Prassas, W.R. McShane	Pearson Educational International, 3rd Edition, 2004.



Course Code	BCIVDEG825					
Category	Programme Elective Course					
Course Title	Environmental Geo-Technology					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 8 (Eighth)
	3	0	0	3	3	
Pre requisites	Engineering Mechanics, Soil Mechanics, Fluid Mechanics, Environmental Engineering					

Course Learning Outcomes (CLOs)

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

i) **CLO1:** Explain the principles of geoenvironmental engineering, soil chemistry, and characterize contaminated soils and subsurface environments

ii) **CLO2:** Analyse contaminant transport mechanisms in saturated and unsaturated soils and groundwater using physical, chemical, and biological principles.

iii) **CLO3:** Design and evaluate engineered waste containment systems, including liners, leachate collection systems, and geosynthetic barriers.

iv) **CLO4:** Select appropriate remediation and ground improvement techniques for contaminated soils and groundwater considering technical, environmental, and economic aspects.

v) **CLO5:** Apply sustainable geoenvironmental engineering principles for waste management, environmental monitoring, and contaminated land restoration.

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	Introduction to Environmental Geotechnology: scope, objectives, and applications, Environmental issues in geotechnical engineering, Soil as a multiphase system, Soil mineralogy, clay-water interaction, and diffuse double layer theory, Physical, chemical, and biological properties of soils, Soil-water-air relationships in saturated and unsaturated soils, Adsorption, cation exchange capacity (CEC), pH, and redox potential, Sources and classification of soil and groundwater contaminants, Environmental regulations and standards Site investigation and laboratory characterization techniques
Module 2.	Contaminant Transport in Soil and Groundwater: Characteristics of organic, inorganic, heavy metal, and emerging contaminants, Groundwater flow fundamentals, Mechanisms of contaminant migration, Sorption, desorption, ion exchange, and chemical reactions, Biodegradation and attenuation mechanisms, Contaminant transport in saturated and unsaturated soils, Mathematical concepts of contaminant transport, Environmental monitoring and groundwater quality assessment, Environmental risk assessment
Module 3.	Waste Management and Engineered Containment Systems: Municipal, industrial, hazardous, mining, and agricultural wastes, Waste characterization and engineering properties, Principles of integrated solid waste management, Landfill planning, siting, and design, Engineered landfill components, Leachate generation, collection, and treatment, Landfill gas generation and utilization, Cover systems and landfill closure, Stability analysis of waste containment facilities, Instrumentation and monitoring of landfills
Module 4.	Remediation of Contaminated Sites: Site investigation and contaminated land assessment, Remediation objectives and selection criteria, Physical remediation methods, Chemical remediation methods, Biological remediation techniques, Phytoremediation, Soil vapour extraction, Pump-and-treat systems, Electrokinetic remediation Stabilization and solidification, Permeable Reactive Barriers (PRBs), Ground improvement techniques for contaminated sites, Monitoring and performance evaluation of remediation systems
Module 5.	Sustainable Geoenvironmental Engineering and Emerging Applications: Sustainable waste management practices, Utilization of fly ash, GGBS, red mud, mine tailings, and dredged materials, Circular economy in geoenvironmental engineering, Carbon sequestration and climate-resilient geotechnical systems. Geosynthetics in environmental protection, Environmental Impact Assessment

	(EIA), GIS and Remote Sensing applications, Life Cycle Assessment (LCA) of waste management systems, Environmental monitoring and instrumentation, Recent advances in geoenvironmental engineering, Case studies on contaminated land restoration and landfill failures

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg CLO
CLO1	3	2	1	2	1	2	3	2	1	1	1	1	1.67
CLO2	3	3	1	3	2	2	3	2	1	1	1	1	1.92
CLO3	3	3	3	2	2	3	3	2	2	3	3	1	2.42
CLO4	3	3	2	3	2	3	3	3	2	3	3	2	2.58
CLO5	3	2	3	2	3	3	3	2	2	3	3	3	2.58
Avg PLO	3.0	2.6	2.0	2.4	2.0	2.62	3.0	2.2	1.6	2.2	2.2	1.6	2.3

S.No:	Text Books	Author	Publisher
1.	Geotechnical and Geoenvironmental Engineering Handbook	Rowe, R. K	Kluwer Academic
2	Geoenvironmental Engineering: Site Remediation, Waste Containment and Emerging Waste Management Technologies.	Sharma, H. D. & Reddy, K. R	Wiley
	References		
1.	Designing with Geosynthetics.	Koerner, R. M	
2.	Hazardous Waste Management. Coduto, D. P., Geotechnical Engineering: Principles and Practices.	LaGrega, M. D., Buckingham, P. L., & Evans, J. C	McGraw-Hill
3.	USEPA Technical Manuals on landfill design, contaminated site remediation, and groundwater monitoring	-	USEPA (United States Environmental Protection Agency)
4.	Geoenvironmental Engineering: Principles and Applications.	Reddi, L. N. & Inyang, H	CRC Press

Course Code	**BCIVPIP825**					
Category	**Lab Course**					
Course Title	**Internship/Industrial Training**					
Scheme and Credits	**L**	**T**	**P**	**No. of Hrs./Week**	**Credits**	**Semester- (Eighth)**
	-	-	-	-	**2**	
Pre requisites	**Fundamental knowledge of civil engineering.**					

Course Learning Outcomes (CLOs)

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

CLO1: Demonstrate an understanding of professional practices, construction methodologies, material production processes, safety regulations, and quality control measures adopted in the Civil Engineering industry.

CLO2: Correlate theoretical concepts learned in the classroom with practical engineering applications through exposure to construction sites, industries, laboratories, or consultancy organizations.

CLO3: Analyze engineering practices, project management techniques, quality assurance procedures, and environmental and safety considerations observed during the industrial training.

CLO4: Prepare a comprehensive industrial training report and effectively communicate the acquired knowledge through technical presentations and viva-voce, demonstrating professional ethics, teamwork, and lifelong learning skills.

Description: The four week training shall be undertaken in a recognized construction organization, consultancy, industry, government department, research organization, or any other approved Civil Engineering establishment to provide practical exposure to professional engineering practices. The Internship/Industrial Training must be of minimum four weeks and should take place during the vacation period. The duration of Internship/Industrial Training can be extended to additional two weeks during the academic session, after the prior permission granted by Head of the Department.

Industrial Training/Internship Report: The Industrial Training/Internship report duly signed and stamped by the competent authority of the host organization, shall be submitted along with all details, pictures, figures drawing and attendance certificate. Failure to submit the report to satisfy requirements may result in the training being treated as incomplete and the student may be required to undergo the training again, as per the Department/University regulations.

The evaluation of Industrial Training-I shall be conducted after the successful completion of both training/internship components and shall be based on the submission of a comprehensive Detailed Industrial Training/Internship Report, duly certified by the concerned organization, followed by a viva voce examination before a designated committee or faculty members nominated by the Head of the Department. The assessment shall be based on the quality of the practical training, the technical knowledge acquired, the quality and comprehensiveness of the report, professional conduct, and overall performance in the viva voce examination.

Module (Internal and External Evaluation)

M. No:	Topic
Module 1.	Bridging the gap between theoretical knowledge with practical applications and execution.
Module 2.	Detailed investigation and understanding of materials, instrumentation, quality control, construction practice and management.
Module 3.	Project planning and scheduling, resource management, socio-economic aspects, and application of the project.
Module 4.	Execution and management of planned project.
Module 5.	Industrial training report writing, technical documentation, presentation skills, professional communication, and future learning outcomes.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO 1	PLO 2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12	Avg. PLO
CLO1	3	3	3	2	2	1	1	1	3	2	3	1	2.08
CLO2	3	3	3	2	2	1	1	1	3	2	3	1	2.08
CLO3	3	3	3	2	2	1	1	1	3	2	3	1	2.08
CLO4	3	3	3	2	2	1	1	1	3	2	3	1	2.08
CLO5	3	3	3	2	2	1	1	1	3	2	3	1	2.08
Avg. CLO	3	3	3	2	2	1	1	1	3	2	3	1	2.08

Course Code	BCIVPPT825					
Category	Lab Course					
Course Title	Project					
Scheme and Credits	L	T	P	No. of Hrs./Week	Credits	Semester- 8 (Eighth)
	0	0	18	18	9	
Pre requisites	Pre-Project, Fundamental Knowledge of Civil Engineering					

Course Learning Outcomes (CLOs)

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

CLO1: Execute the proposed project work by applying appropriate analytical, experimental, computational, or field-based techniques.

CLO2: Analyse and interpret data/results to draw meaningful engineering conclusions.

CLO3: Evaluate the performance, reliability, and limitations of the developed solution.

CLO4: Integrate engineering knowledge with societal, environmental, and sustainability considerations.

CLO5: Prepare a comprehensive technical report and deliver an effective presentation demonstrating project outcomes

Description

The Project course is the culmination of undergraduate studies in Civil Engineering, where students implement the project proposal developed during the pre-work phase. Students work in groups to solve real-world engineering problems through experimental investigation, fieldwork, simulation, or analytical studies. Emphasis is placed on execution, data analysis, interpretation of results, and development of practical and sustainable engineering solutions.

Course Plan

Projects will be undertaken in groups to strengthen technical competency, teamwork, and project management skills. Each group shall carry forward the problem identified during the Project Pre Work course, duly approved by the Project and Training Incharge (PTI). The project work shall involve detailed implementation, experimentation/analysis, validation of results, and formulation of conclusions.

Students are expected to carry out systematic work including data collection, design/analysis, validation, and interpretation using appropriate tools and techniques. Regular interaction with the project supervisor shall be maintained to monitor progress and ensure timely completion.

Assessment will be carried out through continuous evaluation of progress and a final evaluation by an expert committee constituted by the department. The evaluation shall be based on the following:

- Quality and completeness of project implementation
- Data collection, analysis, and interpretation of results
- Application of appropriate engineering tools and techniques
- Innovation, originality, and problem-solving approach
- Consideration of societal, environmental, and sustainability aspects
- Quality of report writing including technical content and organization
- Effectiveness of presentation and demonstration of work
- Ability to answer questions during viva voce

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	3	2	2	2	2	2	3	2	**2.5**
CLO2	3	3	2	3	3	2	2	2	2	2	2	2	**2.33**
CLO3	2	3	3	3	2	3	3	2	1	1	2	2	**2.25**
CLO4	2	2	2	2	2	3	3	3	2	2	2	3	**2.33**
CLO5	1	1	1	1	2	1	1	2	3	3	2	3	**1.83**
Avg PLO	**2.2**	**2.4**	**2.2**	**2.4**	**2.4**	**2.2**	**2.2**	**2.2**	**2**	**2**	**2.2**	**2.4**	**2.23**