Scheme of Instruction, Evaluation

and

Syllabi of

With effect from Academic Year 2024-2025

B.E. Civil Engineering

[Working Professional]

DEPARTMENT OF CIVIL ENGINEERING

UNIVERSITY COLLEGE OF ENGINEERING

(Autonomous)

Esd.1917 **Hyderabad – 500 007, TS, INDIA** **Estd. 1929**

SCHEME OF INSTRUCTION AND EVALUATION
B.E. (CIVIL ENGINEERING) w.e.f. 2024-25

BE V Semester

S.No	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits
			L	T	P		Hrs	CIE	SEE	
Theory										
1	PC 501 CE	Concrete Technology	3	-	-	3	3	40	60	3
2	PC 502 CE	Soil Mechanics	3	-	-	3	3	40	60	3
3	PC 503 CE	Water Resource Engineering -I	3	-	-	3	3	40	60	3
4	PC 504 CE	Theory of Structures-I	3	-	-	3	3	40	60	3
5	PC 505 CE	Design of Reinforced Concrete Structures	3	-	-	3	3	40	60	3
Practicals										
6	PC 551 CE	Concrete Technology Lab	-	-	2	2	3	25	50	1
7	PC 552 CE	Soil Mechanics Lab	-	-	2	2	3	25	50	1
		Total	**15**	**0**	**4**	**19**	21	**250**	**400**	**17**

SCHEME OF INSTRUCTION AND EVALUATION
B.E. (CIVIL ENGINEERING) w.e.f. 2024-25

BE VI SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Evaluation		Credits
			L	T	P		CIE	SEE	
1	PC 601 CE	Environmental Engineering	3	-	-	3	40	60	3
2	PC 602 CE	Theory of Structures-II	3	-	-	3	40	60	3
3	PC 603 CE	Transportation Engineering	3	-	-	3	40	60	3
4	PC 604 CE	Design of Steel Structures	3	-	-	3	40	60	3
5	PC 605 CE	Water Resource Engineering -II	3	-	-	3	40	60	3
Practical									
8	PC 651 CE	Environmental Engg. lab	-	-	2	2	25	50	1
9	PC 652 CE	Transportation Engg. Lab	-	-	2	2	25	50	1
	PW 651 CE	Mini Project	-	-	4	10	50	-	3
			15	**-**	**8**	**29**	300	400	**20**

V SEMESTER

PC 501 CE	CONCRETE TECHNOLOGY					
Pre-requisites	Building Materials and Construction		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60Marks	**CIE**		40Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1.	Understand the characteristics and behavior of the concrete
2.	Describe design aspects of mix design using different methods
3.	Study the importance of admixtures in concrete
4.	Understand the shrinkage and creep mechanisms, curing and durability of concrete
5.	Study the importance of special concretes

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Learn hydration of cement and tests on properties of cement and aggregates.
CO-2	Comprehend the properties and testing of concrete in fresh and hardened state.
CO-3	Knowing the shrinkage and creep mechanisms and durability of concrete.
CO-4	Design concrete mixes by various methods.
CO-5	Familiarize with the types of admixtures, and applications of special concretes

CO-PO Articulation Matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	1	1	-	-	-	1	1	-	1	-	2	-	1
CO2	3	1	1	-	-	-	1	1	-	1	-	2	-	1
CO3	3	2	1	-	-	-	1	1	-	1	-	2	-	1
CO4	3	2	1	-	-	-	1	1	-	1	-	2	-	1
CO5	3	1	1	-	-	-	1	1	-	1	-	2	-	1

Correlation rating: Low/ Medium/High:1/2/3respectively.

UNIT I

Constituents of Concrete:

Cement: Types of cements and their composition- manufacture of Portland cement- hydration of cement and hydration product, Structure of hydrated cement-heat of hydration, Gel theories, tests on properties of cements.

Aggregate: Classification of aggregates, particle shape and texture, bond strength of aggregates and its influence on strength of concrete, porosity, absorption and moisture content and their inf1uence, soundness of aggregate, alkali aggregate reaction, sieve analysis and grading of aggregate, tests on properties of aggregates.

Properties of Fresh Concrete: Mixing and batching, workability, factors effecting workability, various test procedures, segregation and bleeding, vibration of concrete, types of vibrators and their influence on composition, analysis of fresh concrete.

UNIT II

Admixtures used in Concrete: Classification of admixtures. Chemical and mineral admixtures- Influence of various admixtures on properties of concrete. Admixtures used in preparation of self-compacting concrete. Applications, concept of ready mix concrete, fly ash concrete – properties and proportion of fly ash, applications, silica fume, rice husk ash concrete.

UNIT III

Mix Design of Concrete: A basic consideration, process of mix design, factors influencing mix proportions-mix design by ACI method and IS 10262-2019 method, design of high strength concrete, quality control, various methods of mix design, IS code method, British and ACI methods.

UNIT IV

Properties of Hardened Concrete: Strength of concrete as per IS: 516-1959, water cement ratio, Gel space ratio, effective water in the mix, short term and long term properties of concrete, test and procedure, influence of various parameters on strength of concrete, relationship between various mechanical strengths of concrete, curing of concrete, maturity concept, influence of temperature on strength of concrete, stress-strain curves for concrete. Long term properties - Shrinkage and temperature effects - creep of concrete - durability of concrete -permeability of concrete as per IS: 3085 - 1965 - Corrosion - Causes and effects - remedial measures- Thermal properties of concrete - Micro cracking of concrete**.**

UNIT V

Special Concrete: High strength concrete, ferro cement mass concrete, light weight concrete, high density concrete, poly-polymer modified concrete, pre-stressed concrete, self- consolidating concrete, cellular concrete, nano concrete, recycled aggregate concrete, geo polymer concrete, their specialties and applications, Fiber reinforced concrete: Need for fiber reinforced concrete (FRC), Mechanism of FRC, types of Fibers, Fiber shotcrete.

Suggested Reading:

1.	Mehta, P.K. and Paulo, J. M. M., Concrete Microstructure-properties and Material, McGraw-Hill Publishers, 2014.
2.	Neville, A.M. and Brooks, J.J. Concrete Technology, Pearson Education Ltd.,India, New Delhi, 2019
3.	Shetty, M.S, Concrete Technology, Theory & Practice, S.Chand and Co. Pvt., Ltd,2018.
4.	Krishna Raju, N., Design of concrete mix, CBS Publishers, 2017.
5.	Gambhir, M.L, Concrete Technology, Tata McGraw Hill, 2013.
6.	Santha Kumar, A.R., Concrete Technology Oxford University press,New Delhi, 2018
7.	Remedios, A.P., Concrete Mix Design hand book, Himalya PublishingHouse, Hyderabad,2017

PC 502 CE	SOIL MECHANICS					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Introduction of Particulate Mechanics further to the solid and fluid mechanics
2.	Characterization and classification of soils based on laboratory and field experiments
3.	Understanding of seepage, strength and compressibility characteristics of soils and learn the analysis of applications involving them.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Understanding of soils as a three-phase particulate medium. Ability to determine the index properties and based on them, ability to identify and classify the soils.
CO-2	Learn the seepage characteristics of soils and gain competence in seepage analysis.
CO-3	Gain knowledge of compressibility characteristics of the soils through compaction and consolidation processes. Gain competence to conduct the laboratory tests, analyze and apply these processes.
CO-4	Learn shear strength characteristics of soils and gain competence to conduct the laboratory tests, analyse and apply these processes.
CO-5	Ability to compute earth pressure, evaluation of stability of slopes. Adequate preparation for learning the analysis and design of foundation systems to be taught in the following semester

Articulation matrix of Course outcomes with PO‟s:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	2									2	2	2
CO2	2	2		3	2				3	3				
CO3	2	2		3	2	3								2
CO4	3			2	2	3			2	2	2		2	2
CO5	2	3			3	2	1	1			1	2	3	2
Avg	**2.4**	**1.8**	**0.4**	**1.6**	**1.8**	**1.6**	**0.2**	**0.2**	**1**	**1**	**0.6**	**0.8**	**1.4**	**1.6**

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT - I

Origin & Classification of Soils: Soil as a pseudo-elastic three phase particulate medium Physical Properties of soil: Weight ratios (Water content, Density, Unit weights, Specific Gravity); Volume ratios (void ratio, porosity, degree of saturation, relative density); Inter relationships, Laboratory tests for determination of Index properties. Classification and Identification of soils for general and engineering purposes as per IS: 1498-1970.

UNIT - II

Soil Moisture States: Held and Free moisture-Capillarity in Soils: Surface tension and capillary rise in soil, Capillary tension, Capillary pressure. pF value.

Permeability of Soils: Darcy's law for flow through soils - validity of Darcy's Law - Factors affecting permeability - Laboratory tests for determination of co-efficient of permeability (constant head, variable head permeability tests) - Field tests (Pumping in and pumping out tests) - Equivalent permeability of stratified soils.

Seepage in Soils: Seepage flow, seepage pressure - Flow nets - Locating phreatic line in a homogeneous earthen dam using Kogeny's parabola - Computation of seepage quantity.

Stress in Soils: Total, effective and neutral stress distribution in different ground conditions

Quick Sand phenomena: Critical Hydraulic gradient, Remedial measures.

UNIT - III

Compaction Process: Compaction Mechanism; factors affecting compaction. Laboratory determination of compaction characteristics - standard and modified Proctor tests - IS Light and Heavy compaction tests; Field surface compaction: compaction equipment, procedure, quality control.

Consolidation Process: Spring analogy - Void ratio and effective stress (e Vs log p) relationship - Terazaghi's theory of one dimensional consolidation - Assumptions and derivation of GDE- Computation of magnitude of settlement (using Cc, mv) and rate of settlement (cv , Tv, d) classification based on OCR.

UNIT - IV

Shear Strength: Significance of Shear strength in soils - Mohr - Coulomb equation - shear parameters - Laboratory tests for determination of shear strength - Direct shear test, Tri-axial compression test, Un-confined compression test, Vane shear test, Factors affecting shear strength of cohesion-less and cohesive soils.

UNIT - V

Earth Pressure: States of earth pressure - Active, passive, at rest condition; Rankine's theory: Computation of active and passive earth pressure in c-less and cohesive soils; Coulomb's Wedge theory: Rehbhan's graphical solution: stability of earth retaining gravity wall.

Slope stability: Definition and classification of slopes -types of slope failure - Factors of safety with respect to cohesion, angle of shearing resistance, Height - Analysis of stability of slope using Swedish slip circle method and Taylor's stability number.

Suggested Readings

1	Lambe, T.W. and Whitman, R.V., "Soil Mechanics – SI Version ", John Wiley & Sons Inc., NY, 2011.
2	Alam Singh, Soil Engineering in Theory and Practice, Asia Publishing House,1981.
3	Venkataramaiah, C., “Geotechnical Engineering”, New Age Publishers, 2006
4	Murthy, V.N.S., "Soil Mechanics and Foundation Engineering". Dhanpat Rai & Sons, 2006.
5	Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers

	Distributors, revised and enlarged sixth edition, 2007.
6	Das, B. M., "Advanced Soil Mechanics", Taylor and Francis. 7 th Edition (2008)
7	Relevant Codes

PC503CE	WATER RESOURCES ENGINEERING-I					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Providing awareness about water rights and water management principles
2.	Providing Knowledge regarding the fixation gravity dams dimension and fixing various levels in reservoirs
3.	Imparting basic concepts of planning for hydro power projects

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Ability to design and fix up reservoir systems and levels.
CO-2	Understand Gravity principle for design of dams.
CO-3	Capability to understand the seepage through Earthen dams.
CO-4	Understand various failure of tank systems and also ability to design
CO-5	Comprehend various components of Hydro power stations

Articulation matrix of Course outcomes with PO‟s:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	3	3	1		2		1	3	1	1	3	1
CO2	1		1	1	1		2		1	2	1	1	1	1
CO3	3	2	3	3	3		1		1	2	1	1	2	1
CO4	3	2	3	3	1		2		1	3	1	1	2	1
CO5	2	1	2	3	1		2		1	3	1	1	2	2

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT - I

Water Resources Projects: Single and multipurpose projects, general principles of irrigation water rates, components of water allocation systems, riparian rights, groundwater rights, environmental and water quality management aspects of reservoir system operations.

Storage works: Purpose, selection of site, zones of storage, computation of storage capacity,

fixation of different levels of reservoirs (LWL, FRL, MWL), evaporation reduction techniques.

UNIT - II

Dams: Classification of dams, selection of site for a dam, physical factors governing the selection of types of a dam.

Gravity dams : Forces acting on a gravity dam, modes of failure and criteria for structural stability of gravity dams, principal and shear stresses, gravity method of stability analysis, elementary and practical profiles of a gravity dam, high and low gravity dams, functions, and types of galleries in gravity dams, foundation treatment for gravity dams.

UNIT - III

Earth dams: Types of earth dams, causes of failure of earth dams, criteria for the safe design of an earth dam, computation of seepage from flow net, phreatic line in an earth dam (for homogeneous sections with and without filter cases), design of earth dams to suit available materials, embankment and foundation seepage control measures.

UNIT - IV

Tank irrigation: Types, site selection, causes for the failure of tank weirs, design of tank weirs, and general specifications for the construction of tank weirs.

Spillways: Different types of spillways, energy dissipation below spillways, different types of spillway crest gates, stilling basin appurtenances (descriptive details only).

UNIT - V

Hydro-power: Comparison of hydro power with thermal power, classification of hydro power plants, definition of various terms, principal components of hydro-electric power plants (Forebay, intake structure, penstock & surge tank), economical diameter of penstock.

Power house: Substructure and super structure of a power house, merits and demerits of an underground power house, fixation of dimensions of a power house.

Suggested Reading:

1.	Wurbs, R A. and James, W.P., *Water Resources Engineering*, Prentice-Hall of India, New Delhi, 2002.
2.	U.S. Bureau of Reclamation, *Design manual for concrete gravity dams*, Denver, 1976
3.	U. S. Army Corps of Engineers, *Engineering and Design*, CECW-ED Publication, 1995
4.	Punmia B.C. and Pande Lal B.B., *Irrigation and Water Power Engineering*, Lakshmi Publishers, 1993.
5.	Garg *S.K., Irrigation Engineering and Hydraulic Structures*, Standard Book House, 2010
6	M.M. Dandekar and K.N. Sharma, "*Water Power Engineering* 2nd Edition, Vikas Publishing House, Noida, U.P. 2013
7	R.K. Sharma and T.K. Sharma "*A Text book of Water Power Engineering*, S. Chand and Company Pvt. Ltd, New Delhi, 2016

PC504CE	THEORY OF STRUCTURES-I					
Pre-requisites	Basic Knowledge of Engg Mechanics		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	Understand basic methods for the analysis of statically indeterminate beams and frames using various displacement methods
2	To analyse the beams for displacements due to sinking of supports by various displacement methods
3	To evaluate bending moment and shear forces for Three Hinged and Two hinged arches under different Loading Conditions
4	To evaluate bending moment and Shear force of Multi Storied Frames subjected to Vertical loads.
5	To evaluate bending moment and Shear force of Multi Storied Frames subjected to Horizontal loads using various methods.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	To determine displacement for Beam and Portal Frame with and without sinking support using Slope Deflection Method.
CO-2	To determine bending moment and shear force for Beam and Portal Frame with and without sway using Moment Distribution Method
CO-3	To determine displacement for beam and Portal Frame with and without sway using Kani‟s Method.
CO-4	Analyze and sketch bending moment and shear force for three hinged and two hinged arches
CO-5	To analyze multi storied frames using approximate methods for vertical and horizontal loads and sketch bending moment and shear force

Articulation matrix of Course outcomes with PO‟s:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	2	1	2	1	-	-	1	1	1	-	2	1	-
CO2	3	2	1	2	1	-	-	1	1	1	-	2	1	-
CO3	3	2	1	2	1	-	-	1	1	1	-	2	1	-
CO4	3	2	1	2	1	-	-	1	1	1	-	2	1	-
CO5	3	2	1	2	1	-	-	1	1	1	-	2	1	-

Correlation rating: **Low / Medium / High: 1 / 2 / 3 respectively.**

UNIT - I

Slope Deflection Method: Application of the method to continuous beams with and without sinking of supports, single bay - portal frames (Degree of freedom not exceeding three), loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

UNIT - II

Moment Distribution Method: Application of the method to continuous beams with and without sinking of supports, portal frames (static indeterminacy not exceeding three), loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

UNIT - III

Kani's Method: Application of the method to continuous beams with and without support sinking, portal frames (static indeterminacy not exceeding three), and loading on each span may be point load(s) or uniformly distributed load on whole span, shear force and bending moment diagrams.

UNIT - IV

Approximate Method of Analysis.

Multi-storied building frames: Analysis due to vertical loads by substitute frame method – Analysis due to lateral loads by portal method, cantilever method and factor method.

UNIT - V

Elastic Theory of Arches: Eddy's theorem, three hinged parabolic and segmental arches, determination of horizontal thrust, bending moment, normal thrust and radial shear for static loading,C

Two hinged arches: parabolic and segmental, determination of horizontal thrust, bending moment, normal thrust and radial shear for static loading

Suggested Reading:

1.	D.S. Prakash Rao, *Structural Analysis- A Unified Approach*, University Press, 1999
2.	B.C. Punmia and A.K. Jain, *Theory of structures*, Laxmi Publications, New Delhi, 2004
3.	Pandit, G .S., S. P. Gupta and R. Gupta, *Theory of Structures*, Vol.l, Tata McGraw Hill, New Delhi, 1999.
4.	S.B. Junarkar, *Mechanics of Structures* (Vol. 1 &2), Charotar Publishing House Anand, 1992.
5.	C.S.Reddy, *Basic Structural Analysis*, Tata McGraw-Hill Publishing Co. Ltd., New Delhi
6	Vazirani & Ratwani , *Analysis of structures* – Vol. I & II Khanna publications

PC 505CE	DESIGN OF REINFORCED CONCRETE STRUCTURES					
Pre-requisites	Strength of Materials		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Note: All relevant latest IS codes necessary for this course may be referred (i.e. IS 456-2000 etc.)

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1.	Know the IS code provisions for working stress design of beams.
2.	Understand limit state of collapse design for flexure, shear and torsion, and limit state of serviceability.
3.	Learn limit state of collapse and serviceability design of slabs and dog-legged staircases.
4.	Study limits state of collapse design of columns without and with bending.
5.	Learn limit state of collapse design of isolated and combined footings.

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Solve design of beams using working stress method.
CO-2	Answer design of beams using limit state method.
CO-3	Work out design of slabs and dog-legged staircases using limit state method.
CO-4	Evaluate design of columns using limit state method.
CO-5	Design isolated and combined footings using limit state method.

Articulation matrix of Course outcomes with PO‟s:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	1	2	2	3	3	3	1	2	3	3
CO2	2	3	3	2	1	2	2	3	3	3	1	2	3	3
CO3	2	3	3	2	1	2	2	3	3	3	1	2	3	3
CO4	2	3	3	2	1	2	2	3	3	3	1	2	3	3
CO5	2	3	3	2	1	2	2	3	3	3	1	2	3	3

Correlation rating: Low/ Medium/High: 1/2/3 respectively

UNIT - I

Design Philosophies: Development of design philosophies, Working stress method, Ultimate load method, and Limit state method, Concepts, Characteristic loads and strengths, Partial safety factors, Stress-strain relationship for concrete and steel, Stress block parameters.

Working Stress Method: Design of RCC beams, Balanced, under-reinforced and over-reinforced

sections, Design of singly and doubly reinforced rectangular, T and L beam sections.

UNIT - II

Limit State of Collapse in Flexure: Assumptions, Design for flexure - Singly and doubly reinforced rectangular, T and L beam sections.

Limit State of Collapse in Shear, Bond and Torsion: Design of beam for shear, bond and torsion.

Limit State of Serviceability: Check for deflection and cracking.

UNIT - III

Design of Slabs (Limit State Method): Design of one way and two way slabs - Simply supported and continuous slabs subjected to uniformly distributed loads, Detailing of reinforcement, Check for serviceability of slabs.

Design of Staircases (Limit State Method): Types of stairs, Effective span, Distribution of loading on stairs, Design and detailing of dog-legged staircases.

UNIT - IV

Design of Columns (Limit State Method): Assumptions, Design of axially loaded circular, square and rectangular columns, Design of columns with uni-axial and bi-axial bending, interaction diagrams.

UNIT - V

Design of Footings (Limit State Method): Design of isolated footings of uniform depth and sloped footings, Design of square, rectangular and circular footings as per IS code, Design of combined rectangular slab footing, Combined rectangular beam and slab footing for two columns.

Suggested Reading:

1	Robert Paul and Thomas Paulay, Reinforced Concrete Structures, John Wiley & Sons, 1974.
2	Punmia B.C., Jain A.K. and Jain A.K., RCC Designs, Laxmi Publications, 2006
3	Krishna Raju N. and Pranesh R.N., Reinforced Concrete Design, New Age International Pvt. Ltd., 2003.
4	Varghese P.C., Limit State Design of Reinforced Concrete, Prentice Hall of India Pvt. Ltd., 2002.
5	Varghese P.C., Design of Reinforced Concrete Foundations, Prentice Hall of India Pvt. Ltd., 2009.
6	D.S. Prakash Rao, Design Principles and Detailing of Concrete Structures, Tata McGraw Hill Publishing Co. Ltd., 1995.

PC551CE	CONCRETE TECHNOLOGY LAB					
Pre-requisites	Concrete Technology		**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1.	Determine behavior of materials through physical tests.
2.	Infer suitability of materials in construction.
3.	Able to prepare concrete as per the standards

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	To determine the properties of constituents of concrete
CO-2	Design and prepare concrete mix using Indian Standard method.
CO-3	To identify the fresh and hardened properties of concrete.
CO-4	Assess characteristic of concrete using Non- destructive testing methods.
CO-5	To correlate experimental results between non destruction and destruction method.

Articulation matrix of Course outcomes with PO‟s:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	2	2	-	3	2	-	1	1	1	1	-	1	-	1
CO2	2	2	2	3	2	-	1	1	1	1	-	1	-	1
CO3	2	2	-	3	2	-	1	1	1	1	-	1	-	1
CO4	2	2	-	3	2	1	1	1	1	1	-	1	1	1
CO5	2	2	-	3	2	1	1	1	1	1	-	1	1	1

Correlation rating: Low/ Medium/High: 1/2/3respectively.

LIST OF EXPERIMENTS

1. (a) Determination of Specific gravity of cement

(b) Determination of unit weight / bulk density of cement

2. Determination of normal consistency of cement

3. (a) Determination of initial setting time of cement

4. Determination of final setting time of cement

5. (a) Preparation of mortar cubes for compressive strength

(b) Tests on mortar cubes for compressive strength

6. Fineness of cement by sieving and by air permeability method

7. (a) Determination of specific gravity of fine aggregate

(b) Determination of bulk density of fine aggregate

8. (a) Determination of specific gravity of coarse aggregate

(b) Determination of bulk density of coarse aggregate

9. Tests on bulking of sand

(a) Laboratory method (b) Field method

10. Determination of fineness modulus of fine aggregate

11. Determination of fineness modulus of coarse aggregate

12. Test son workability of concrete

(a) Slump (b) Compaction factor

13. Tests on hardened concrete (a) Compressive strength (b) Flexural strength

14. Non-destructive testing of concrete structures demonstration of rebound hammer, UPV system, profometer corrosion meter and IR method

References:

1.	**IS 12269-2013**, "Ordinary Portland Cement, 53 Grade Specifications", *Bureau of Indian Standards*, New Delhi
2.	**IS: 2386 (Part III, 1963)(R2016),** "Methods of Tests for Aggregates for Concrete", *Bureau of Indian Standards*, New Delhi
3.	**IS: 383-2016**, "Specification for Coarse and Fine Aggregates from Natural Sources for Concrete", *Bureau of Indian Standards*, New Delhi
4.	**IS: 10262-2009**, "Concrete Mix Proportioning – Guidelines", *Bureau of Indian Standards*, New Delhi
5.	**IS: 1199-2018 (Part IV)**, "Fresh Concrete- Methods of Testing, Sampling and Analysis ", *Bureau of Indian Standards*, New Delhi
6.	**IS: 516-1959**, "Methods of Tests for Strength of Concrete", *Bureau of Indian Standards*, New Delhi
7.	**IS 13311(Part1& 2):1992**, "Nondestructive testing of concrete-Methods of test", *Bureau of Indian Standards*, New Delhi

PC552CE	SOIL MECHANICS LABORATORY					
Pre-requisites			**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student	
1.	Expose the students to different types of soils
2.	Experience the concepts of soil mass, soil solids, and soil structure.
3.	Understand the laboratory test procedures and appreciate the suitability of each test.
4	Make the students to relate theoretical concepts in doing lab tests.

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Ability to process soil sample and prepare test specimen simulating the in-situconditions
CO-2	Competence to launch the specimen, fix the instrumentation, perform the test and to record the observations
CO-3	Ability to analyses the data, find the test results, make critical observation on appropriateness of the result and its application
CO-4	Greater insight in to the soil behavior and hence enhanced understanding of soil mechanics
CO-5	Ability to model a field application in the laboratory to take up research

Articulation matrix of Course outcomes with PO‟s:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	2		1	2	2				2			1	2	2
CO2			1	1	3				3			2	2	2
CO3	3	3		2	2	1		1		2		1		2
CO4	2		2	2			2			2	1	1		1
CO5	2	2	2	3	2	1	2	2		2	2	2	3	3

Correlation rating: Low/ Medium/High:1/2/3respectively.

List of Experiments:

I. DETERMINATION OF INDEX PROPERTIES:

Determination of

1. Specific Gravity of soil solids using
    a. Density bottle method
    b. Pycnometer method
2. Water content using
    a. Oven drying method
    b. Pycnometer method
3. Liquid and Plastic limit
4. Sieve Analysis
5. Classification of Soils as per IS:1498-1970
6. Field Density using Sand Replacement Method

II. DETERMINA TION OF ENGINEERING PROPERTIES:

Determination of

7. Compaction Characteristics using
    a. IS Light Compaction Test
    b. IS Heavy Compaction Test
    c. Compare and find the effect of Compaction Effort on Compaction mechanism
8. Co-efficient of Permeability by
    a. Constant Head Permeameter test
    b. Variable Head Permeameter test
9. Shear strength parameters by
    a. Direct Shear Test
    b. Unconfined Compression Test
    c. Vane Shear Test
10. California Bearing Ratio (CBR) value

III. DEMONSTRATION OF TEST PROCEDURE:

11. Consolidometer test
12. Tri-axial compression Test
13. Laboratory Plate Load Test
14. Reverse Osmosis Test
15. Quick Sand Model
16. Cyclic Tri-axial Test Facility

Suggested Reading :

1. IS:2720 – Relevant Parts.
2. Lambe, T.W., "*Soil Testing for Engineers*", Wiley Eastern Ltd., New Delhi, 1969.

SCHEME OF INSTRUCTION AND EVALUATION
B.E. (CIVIL ENGINEERING) w.e.f. 2024-25

BE VI SEMESTER

S. No.	Course Code	Course Title	Scheme of Instruction			Contact hr/week	Scheme of Evaluation		Credits
			L	T	P		CIE	SEE	
1	PC 601 CE	Environmental Engineering	3	0	0	3	40	60	3
2	PC 602 CE	Theory of Structures-II	3	0	0	3	40	60	3
3	PC 603 CE	Transportation Engineering	3	0	0	3	40	60	3
4	PC 604 CE	Design of Steel Structures	3	0	0	3	40	60	3
5	PC 605 CE	Water Resource Engineering -II	3	-	-	3	40	60	3
Practical									
8	PC 651 CE	Environmental Engg. lab	0	0	2	2	25	50	1
9	PC 652 CE	Transportation Engg. Lab	0	0	2	2	25	50	1
	PW 651 CE	Mini Project	-	-	10	10	50	-	3
			15	**-**	**14**	**29**	340	400	**20**

CHEME OF INSTRUCTION AND EVALUATION
B.E. (CIVIL ENGINEERING) Applicable w.e.f. 2024-25

BE VI – Semester

PC601CE	**ENVIRONMENTAL ENGINEERING**					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Introduction to the basic concepts and requirements of environmental engineering
2.	Knowledge about different sequential unit operations of water and wastewater treatment processes
3.	Inputs on engineering principles for analyzing various environmental issues
4	Awareness towards the sustainability of standards for water resources
5	

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Aptitude to plan for protected water supply system needs and requirements
CO-2	Ability to design sequential unit operations in water treatment plants
CO-3	Acquaintance with collection procedures and design of sewerage systems
CO-4	Capacity to design for the safe disposal of wastewater and its reuse
CO-5	Knack to analyze, execute and maintain standards for sustainable development of the society

Articulation matrix of Course outcomes with PO"s:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	--	--	1	3	3	3	2	2	2	3	2
CO2	3	2	2	1	1	2	3	2	1	2	2	2	1	2
CO3	2	--	2	--	3	1	2	2	1	1	1	1	3	1
CO4	2	1	2	1	1	2	1	1	--	1	1	2	2	1
CO5	2	1	3	--	2	1	3	1	2	2	1	2	1	3

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT-I

Water Supply: Need for planned water supply schemes, water demand for industrial and agricultural water requirements, Sources of water, standards and quality issues, water quality

requirements for different beneficial uses, Population Forecast, water treatment through aeration, coagulation flocculation, and sedimentation.

UNIT – II

Water Treatment: Filtration, Disinfection, and Softening, methods of layout of distribution pipes, design of distribution by Hardy Cross method for simple networks, various types of pipes and valves used in water supply systems.

UNIT – III

Sewage: Domestic and Storm water, Quantity of Sewage, Sewage flow variations.
Conveyance of sewage: Sewers shapes, design of sewerage systems, operation and maintenance of sewers, sewage pumping, sewer appurtenances

UNIT-IV

River cleaning plans: Self-purification of streams, BOD and COD concepts, wastewater treatment, aerobic and anaerobic treatment system, suspended and attached growth systems, quality requirements of recycled water for various purposes. Principles of Septic Tank

UNIT-V

Advanced WWT concepts: Theory and design concepts of Activated Sludge Process, Mechanically Aerated Lagoons, Sequencing Batch Reactor (SBR), Waste Stabilization Ponds, basic concepts of Bio-Remediation**.**

Suggested Reading:

1.	Fair, G. M. and Geyer, J. C. *Water and Wastewater Engineering, vol. I and II*, John Wiley & Sons, Inc., New York, 1954
2.	Hammer, M.J. and Hammer, M.J. Jr., *Water and Wastewater Technology*, Prentice-Hall of India Pvt. Ltd., New Delhi, 1998
3.	Metcalf & Eddy, *Wastewater Engineering, treatment, disposal, and reuse*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1995
4.	Gilbert, M. Masters., *Introduction to Environmental Engineering and Science*, Prentice-Hall of India Pvt. Ltd., New Delhi, 1995
5.	Norris, Robert, *Handbook of Bioremediation*, CRC Press, 1993
6	A. Pytel and F. L. Singer, *Strength of Materials*, Harper & Row, Fourth Edition, NewYork, 1987.

PC 602CE	THEORY OF STRUCTURES- II					
Pre-requisites	Theory of Structures-I		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Understand the analysis of structural elements subjected to various types of moving loads
2.	To understand behavior of the suspension bridge and analyze for stresses along with suspension girder.
3.	To evaluate bending moment and shear forces of various structural elements using matrix method of analysis
4.	Illustrate the matrix methods of structural analysis for computer applications
5.	

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Sketch ILD for bending moment and shear force, for determinate girders for different position of loading system and for different sections of girder
CO-2	Analyze cable suspension bridges along with three hinged stiffening girder for static loads
CO-3	Analyze the redundant beams and frames Using Flexibility method
CO-4	Analyze redundant members using direct stiffness method
CO-5	Calculate the bending moment and shear force and sketch the BMD and SFD for redundant members using force and displacement methods

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	2	1	2	1	-	-	1	1	1	-	2	1	-
CO2	3	2	1	2	1	-	-	1	1	1	-	2	1	-
CO3	3	2	1	2	1	1	1	1	1	1	-	2	1	-
CO4	3	2	1	2	1	1	1	1	1	1	-	2	1	-
CO5	3	2	1	2	1	1	1	1	1	1	-	2	1	-

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT - I

Moving loads: Influence line for support reaction, bending moment and shear force at any location for simple beams. Determination of maximum bending moment and shear force for moving load systems on simply supported girders.

Curves of maximum bending moment and shear force: for simply supported girders traversed by (l) single point load, (2) two point loads, (3) uniformly distributed-load longer/shorter than span, enveloping parabola and EUDLL

UNIT - II

Moving loads on trusses / girders: Influence lines for forces in members of statically determinate plane framed structures under moving loads for Warren girder, Pratt truss, and Curved flange truss.

Suspension bridges: Stresses in suspended loaded cables, length of cable, simple suspension bridge with 3-hinged stiffening girders for static load, Influence lines for horizontal and vertical components of tension in the cable, tension in the cable, bending moment and shear force.

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UNIT - III

Flexibility Matrix Method: Determination of Static and kinematic indeterminacy - Equilibrium and compatibility conditions-Principles of superposition, Application of Flexibility Matrix Method to continuous beams, plane trusses, plane frames and ortho grid structures (Static indeterminacy not exceeding three) - Effect of temperature, Lack of fit and Pre-stressing forces

.

UNIT – IV

Stiffness Matrix Method: Application of Stiffness Matrix Method to continuous beams, plane trusses, plane frames and ortho grid structures (Degree of freedom not exceeding three). Construction of stiffness matrix for frames - Direct Method

UNIT - V

Direct Element Method: Development of stiffness matrices for bar, truss and beam elements. Application of direct element method to problems of axially loaded bars, continuous beams, plane trusses and plane frames to obtain joint displacements and member end forces. Developing shear force and bending moment diagrams. Introduction to software package STAAD Pro

Suggested Reading:

1.	D.S. Prakash Rao, *Structural Analysis- A Unified Approach*, University Press, 1999
2.	B.C. Punmia and A.K. Jain, *Theory of structures*, Laxmi Publications, New Delhi, 2004
3.	Pandit, G .S., S. P. Gupta and R. Gupta, *Theory of Structures*, Vol.l, Tata McGraw Hill, New Delhi, 1999.
4.	P.N Godbole, R.S Sonparote, & S.U Dhote Matrix method of Structural Analysis PHI learning Private Limited , New Delhi 2014
5.	C.S.Reddy, *Basic Structural Analysis*, Tata McGraw-Hill Publishing Co. Ltd., New Delhi
6	Thandavamoorthy , *Structural Analysis* – Oxford Higher Education,2011

PC603CE	TRANSPORTATION ENGINEERING					
Pre-requisites			**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1	Emphasize the significance of geometric design of highways with specifications and standards
2	To describe basic techniques for collecting and analysing traffic data, diagnosing problems.
3	To impart knowledge on pavement materials
4	Create awareness on Flexible pavement design
5	Impart knowledge on Rigid pavement design

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Assimilation of the various concepts of Highway geometric design
CO-2	Application of concepts related to traffic engineering
CO-3	Knowledge related to selection of pavement materials
CO-4	Able to design flexible pavements
CO-5	Analyze and Design the rigid pavements

CO-PO Articulation Matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	2	3	2	1	2								2	
CO2	2	2	2	2	2								3	1
CO3	2	2	3	1	1		2					1	2	2
CO4	2	2		1	2		2				2		3	2
CO5	2	2	2	1	2		2				2	1	1	2

Correlation rating: Low/ Medium/High:1/2/3respectively.

UNIT-I

Highway development and planning-Classification of roads, road development in India, Current road projects in India; highway alignment and project preparation.

Geometric design of highways- Introduction; highway cross section elements; sight distance, design of horizontal alignment; design of vertical alignment; design of intersections, problems

UNIT-II

Traffic Engineering & control- Traffic Characteristics, traffic engineering studies, traffic flow

and capacity, traffic regulation and control; Type of road markings & Signs; design of signals, capacity analysis and design of rotary intersections, parking facilities; accident studies; highway lighting; problems.

UNIT-III

Pavement materials- Materials used in Highway Construction; desirable properties, tests, requirements for different types of pavements: Soils, Stone aggregates, bituminous binders, bituminous paving mixes, introduction to Marshall Mix method; Portland cement, types of cement concrete: desirable properties, tests on cement and hardened concrete, requirements for different types of pavements; problems.

UNIT IV

Flexible Pavements-Types of pavements and factors affecting design of flexible pavement, performance; stresses in flexible pavements; design of flexible pavements as per IRC:37-2018; Surface and Sub-surface drainage systems, Thickness design problems. Distresses in flexible pavement, causes and performance indicators.

UNIT-V

Rigid pavements- Components and functions; factors affecting design stresses in rigid pavements; types of joints, design of concrete pavements as per IRC:58-2015; Design of dowel bars and tie bars, Distresses, causes and performance of CC pavements. Design problems.

Suggested Reading:

1.	Khanna, S.K., Justo, C.E.G and Veeraragavan, A, 'Highway Engineering', Revised 10th Edition, Nem Chand & Bros, 2017
2.	Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski,'Principles of Highway Engineering and Traffic Analysis', 4th Edition, John Wiley
3.	Paul H. Wright and Karen K. Dixon, Highway Engineering, 7th Edition, Wiley Student Edition, 2009.
4.	Kadiyali, L.R, Lal N.B, „Principles and Practices of Highway Engineering" Khanna Publishers, 2013
5.	IRC: 37 (2018), „Guidelines for the design of flexible pavements", Indian Roads Congress, New Delhi
6.	IRC: 58 (2015), „Guidelines for the design of plain jointed rigid pavements", Indian Roads Congress, New Delhi

PC604CE	DESIGN OF STEEL STRUCTURES					
Pre-requisites	Mathematical Knowledge		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1.	Know the IS codal provisions as applicable for the designs.
2.	Understand the material behavior and basics of design of steel structures.
3.	Learn the design of various members along with the connections.
4.	Know the design principles of roof trusses.

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Acquire knowledge of IS codal provisions and design of different types of connections.
CO-2	Able to design any type of tension members.
CO-3	Competent to design various kinds of compression members and column bases.
CO-4	Capable to design different types of beams
CO-5	Proficient to design any type of roof trusses

Articulation matrix of Course outcomes with PO"s:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2
CO1	3	3	3	3		3		3	3	3	2	3	3	3
CO2	3	3	3	3		3		3	3	3	2	3	3	3
CO3	3	3	3	3		3		3	3	3	2	3	3	3
CO4	3	3	3	3		3		3	3	3	2	3	3	3
CO5	3	3	3	3		3		3	3	3	2	3	3	3

Correlation rating: Low / Medium / High: 1 / 2 / 3 respectively.

UNIT-I:

Materials and Specifications: Chemical composition of steel, types of Structural Steel, Residual stresses, Stress Concentration. **Basis of Structural Design**: Codes and Specifications, Design Philosophies, working Stress Method, Limit State Method.

Loading and Load Combinations**: Characteristic Loads, Dead Loads, Imposed Loads, Earthquake Loads, Wind Loads and Load Combinations. Partial safety factors for materials and loads.**

Bolted Connections (Limit state method): **Bolted Connections, Behavior of Bolted Joints, Design Strength of Ordinary Black Bolts, Design Strength of High Strength Friction Grip Bolts, Pin Connections, Simple Connections and Eccentric Connections.**

Welded Connections (Limit State Method): Advantages of Welding, Types of Welds and Joints, Simple Connections and Eccentric Connections.

UNIT-II

Design of Tension Members (Limit State Method): Types of Tension Members, Design of Strands, Slenderness Ratio, Modes of Failure, Factors Effecting Strength of Tension Members, Design of Tension Members (Angles, Other sections and Rods), Lug Angles, Tension Member Splice.

UNIT-III

Design of Compression Members (Limit state method): Introduction, Possible Failure Modes, Behavior of Compression Members, Elastic Buckling of Slender Compression Members, Behavior of Real Compression Members, Sections of Compression Members, Effective Length, Design of Compression Members with Single Section and Built-up Sections (Symmetric in both directions), Lacing and Battening, Column Splices. Design of Column Bases (Limit state method): Design of Slab Base and Gusseted Base for Columns.

UNIT-IV

Design of Beams (Limit state method): Types of Beams, Section Classification, Lateral Stability of Beams, Buckling of Real Beams, Behavior of Beams in Bending, Design of Laterally Supported and Unsupported Beams, Design of Compound Beams, Shear Strength of Beams, Maximum Deflection, Web Buckling and Web Crippling, Biaxial Bending and Unsymmetrical Bending.

UNIT- V

Design of Roof Trusses (Limit state method): Types of Trusses, End Bearings, Spacing of Trusses and Purlins, Estimation of Loads with different Roof Coverings, Self-weight of Truss, Wind Effects, Design of Purlins for Dead Load, Imposed Load and Wind Loads. Detailed Design of Roof Trusses including Joints and Supports (only Angular Trusses).

Suggested Reading:

1.	Subramanian. N, *Design of Steel Structures*, Oxford University Press, 2008
2.	Duggal S.K., *Design of Steel Structures*, Tata McGraw Hill Publishing, 2009.
3.	Shiyekar M.R., *Limit State Design in Structural Steel*, PHI Learning Pvt. Ltd., 2010.
4.	Bhavikatti, S.S., *Design of Steel Structures*, I.K. International Publishing House Pvt. Ltd. 2010.
5	Gambhir M.L., *Fundamentals of Structural Steel Design*, McGraw Hill Education, 2013.
6	IS : 800 - 2007, *General Construction In Steel - Code of Practice*, Bureau of Indian Standards, New Delhi.
7	IS : 875 (Part 1) – 1987, *Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Part 1 Dead Loads - Unit Weights of Building Materials and Stored Materials*, Bureau of Indian Standards, New Delhi.
8	IS : 875 (Part 2) – 1987, *Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Part 2 Imposed Loads*, Bureau of Indian Standards, New Delhi.
9	IS : 875 (Part 3) – 2015, *Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Part 3 Wind Loads*, Bureau of Indian Standards, New Delhi.
10	IS : 875 (Part 4) – 1987, *Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Part 4 Snow Loads*, Bureau of Indian Standards, New Delhi.
11	IS : 875 (Part 5) – 1987, *Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Part 5 Special Loads and Combinations*, Bureau of Indian Standards, New Delhi.
12	IS : 1893 (Part 1) – 2016, *Criteria for Earthquake Resistant Design of Structures, Part 1 General*

	Provisions and Buildings, Bureau of Indian Standards, New Delhi.

PC 605CE	WATER RESOURCES ENGINEERING –II					
Pre-requisites	Fluid Mechanics -I		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	60 Marks	**CIE**		40 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student to:	
1.	To provide design based on seepage theory for weirs and barrage structures
2.	To impart knowledge regarding the alluvium principles and silt theory in canals
3.	To describe design aspects of different types of canal regulatory systems

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Ability to design the design floor thickness based on seepage theory
CO-2	Understand creep theories and design components of diversion head works
CO-3	Capability to design canals based on Alluvium principles
CO-4	Understand importance and design aspects of canal falls
CO-5	Comprehend various components of cross drainage works

Articulation matrix of Course outcomes with PO‟s

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	3	1		2		1	3	1	1	3	1
CO2	1	2	2	2	3		2		1	3	1	1	1	2
CO3	3	2	3	3	3		1		1	2	1	1	2	2
CO4	3	2	3	3	1		2		1	3	1	1	3	2
CO5	2	1	2	3	1		2		1	3	1	1	2	1

Correlation rating: Low/ Medium/High: 1/2/3 respectively

UNIT-I

Weirs: Components of diversion head works, types of weirs – fixation of still level of head sluice, scouring sluice and crest level of weir, afflux and top level of flood banks, design of vertical drop and sloping glacis weir, design for surface flow and sub - surface flow, length, level and thickness of downstream apron, upstream and downstream cutoffs, protection works.

UNIT – II

Seepage forces: Causes of failure of structures on permeable foundations, piping, rupture of floor, undermining,

remedial measures, computation of uplift forces by Bligh‟s theory, Khoshla‟s theory, analytical method, and significance of exit gradient.

UNIT-III

*Canals:*Alignment, classification of alluvium canals and their functions, Regime concept of Kennedy's and Lacey's theories, design of canals based on Kennedy's and Lacey's method,
use of Garrett's diagrams for the design of canals, lining of canals, methods of lining and design of lined canals.

UNIT- IV

Canal falls: Definition, location, types of falls, design principles of trapezoidal notch fall, vertical drop fall, glacis fall.
Regulators and modules: Head regulator and cross regulators, canal escapes, canal outlets and modules-proportionality, sensibility and flexibility.

UNIT- V

Cross drainage works: Definition, classification, design principles of aqueducts, syphon aqueducts, canal syphons, super passages, inlets and outlets-selection of cross drainage works.

Suggested Reading:

1	B.C. Punmia and Pande B.B. Lal, Irrigation and Water Power Engineering, Standard Book House, 1991.
2.	S.K. Garg, Irrigation and Hydraulic Structures, Khanna Publishers, 1993.
3.	Modi P.N., Irrigation and Water Resources and Water PowerEngineering, Standard Book House, 1983.
4.	S. K. Sharma “Irrigation Engineering & Hydraulic Structures” S. ChandPublishers, New Delhi 2016
5.	Punmia, B.C., Pande B. and Lal, B, Ashok Kumar Jain & Arun Kumar Jain., „Irrigation and Water Power Engineering‟, Laxmi Publishers, 2003

PC 651 CE	**ENVIRONMENTAL ENGINEERING LABORATORY**					
Pre-requisites	Fluid Mechanics		**L**	**T**	**P**	**C**
			-	-	2	1
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives:	
The course is taught with the objectives of enabling the student	
1.	introduction to characterization of water and wastewater
2.	Knowledge of experiments for water quality assessment
3.	To verify the efficacy of some water treatment processes

Course Outcomes:	
On completion of this course, the student will be able to:	
CO-1	Knack to interpret and analysis the experimental data
CO-2	Ability to apply the laboratory results for providing technical solutions
CO-3	Capacity to write a technical report based on the experimental results

Articulation matrix of Course outcomes with PO‟s:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	2	-	2	1	-	-	1	2	3	-	1	2	1
CO2	3	2	-	2	1	-	-	1	2	3	-	1	2	2
CO3	3	2	-	2	1	-	-	1	2	3	-	1	2	2

Correlation rating: Low/ Medium/High:1/2/3respectively.

List of Experiments:

1. A) Determination of total dissolved solids
   B) Determination of total suspended solids
   C) Determination of fluorides
2. Determination of total hardness
3. Determination of alkalinity
4. Determination of chlorides
5. Determination of sulphates

6. Determination of MPN
7. Determination of residual chlorine
8. Determination of optimum alum dosage
9. Determination of BOD
10. Determination of COD

PC652CE	TRANSPORTATION ENGINEERING LABORATORY					
Pre-requisites	Transportation Engineering		**L**	**T**	**P**	**C**
			3	-	-	3
Evaluation	**SEE**	50 Marks	**CIE**		25 Marks	

Course Objectives:	
1	To study the basic tests on road aggregate
2	To study the basic tests on bitumen
3	Create awareness on traffic studies

Course Outcomes :	
CO-1	Assimilation of the various concepts of Pavement Materials
CO-2	Understanding and application of test on road aggregates
CO-3	Knowledge related to selection of bituminous binders
CO-4	Able to solve the traffic related issues
CO-5	Knowledge on design bituminous mixes

Articulation matrix of Course outcomes with PO's:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	1											
CO2	2	3	2	2		2	1		1	2		1	1	
CO3	2	3	2	2		2	1		1	2		1	1	
CO4	2	3	3	3	2	2	2		3	2	1	1	2	2
CO5	2	1												

Correlation rating: Low/ Medium/High:1/2/3 respectively

A) **Tests on Bitumen:**

1) Penetration test
2) Ductility test
3) Softening point test
4) Specific Gravity test
5) Viscosity test,
6) Flash and Fire point test

B) **Tests on Aggregate:**

1) Aggregate Crushing test,
2) Los Angles Abrasion test,
3) Aggregate Impact test,
4) Shape test,
5) Specific gravity and Water Absorption,
6) Soundness

C) **Experiments on Traffic:**

1) Traffic Volume study
2) Spot speed study

3) Speed and delay study
4) Origin & Destination study

D) **Miscellaneous Tests (Demo):**

1) Marshall Stability,
2) Bitumen Extraction
3) Stripping test
4) DCP test

Suggested Reading:

1.	Khanna SK and Justo CEG, „Highway material testing" (Lab manual), Nem Chand & Bros
2.	Relevant IS and IRC Codes of practice

PW651CE	**MINI PROJECT**					
Pre-requisites			**L**	**T**	**P**	**C**
				-	4	3
Evaluation	**SEE**	50 Marks	**CIE**		-	

Course Objectives :	
The course is taught with the objectives of enabling the student to:	
1	Identification of the research problem
2	Discussion and critical appraisal of literature review.
3	Discussion of Methodology for the research problem

Course Outcomes :	
On completion of this course, the student will be able to :	
CO-1	Identify Civil Engineering problems by reviewing available latest literature.
CO-2	Study different techniques and analyze the systems.
CO-3	Provide appropriate solutions for the identified problem.

Articulation matrix of Course outcomes with PO‟s:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2	2	-	1	1	2	-	1	2	2
CO2	2	2	1	-	1	1	-	-	-	-	-	-	2	1
CO3	2	2	1	-	1	1	-	-	-	-	-	-	2	1

Correlation rating: Low/ Medium/High: 1/2/3 respectively

Mini Project will have End Semester Evaluation. The evaluation includes Presentation containing identification of the problem based on the literature review on the topic referring to latest literature available.

End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals‟ contribution. Continuous assessment of Mini Project will be monitored by the departmental committee.