K. K. Wagh Institute of Engineering Education and Research, Nashik

Department of Civil Engineering

Third Year B. Tech

Civil Engineering

Syllabus

Pattern: 2022

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T.Y. B. Tech wef AY 2024-25																	
SEM-V																	
Course Code	**Course Type**	**Title of Course**	**Teaching Scheme**			**Evaluation Scheme and Marks**								**Credits**			
			TH	**TU**	**PR**	**INSEM**	**ENDSEM**	**CCE**	**TUT**	**TW**	**PR**	**OR**	**TOTAL**	**TH**	**TU**	**PR**	**TOTAL**
CIV223001	DCC	Geotechnical Engineering	3	-	-	20	60	20	-	-	-	-	**100**	3	-	-	**3**
CIV223002	DCC	Design of Reinforced Concrete	3	-	-	20	60	20	-	-	-	-	**100**	3	-	-	**3**
CIV223003	DCC	Hydrology & Water Resources Engineering	3	-	-	20	60	20	-	-	-	-	**100**	3	-	-	**3**
CIV223004	DCC	Geotechnical Engineering Lab	-	-	2	-	-	-	-	25	-	25	**50**	-	-	1	**1**
CIV223005	DCC	Design of Reinforced Concrete Structures Lab	-	-	2				-	25	-	25	**50**	-	-	1	**1**
CIV223006	DEC	Elective I	3	-	-	20	60	20	-	-	-	-	**100**	3	-	-	**3**
CIV223007	DEC	Lab work in Elective I	-	-	2	-	-	-	-	25	-	25	**50**	-	-	1	**1**
CIV223008	OEC	Safety Management	2	-	-	-	-	50	-	-	-	-	**50**	2	-	-	**2**
CIV223009	ESC	Air Pollution & Control	3	-	-	20	60	20	-	-	-	-	**100**	3	-	-	**3**
CIV223010	PSI	Seminar	-	1	2	-	-	-	25	25	-	-	**50**	-	1	1	**2**
Total			**17**	**01**	**08**	**100**	**300**	**150**	**25**	**100**	**-**	**75**	**750**	**17**	**1**	**4**	**22**

Elective Streams	Course Code (TH)	Course Code (PR)	Elective I (SEM V)
Concrete	CIV223006A	CIV223007A	Advanced Concrete Technology
Management	CIV223006B	CIV223007B	Operation Research
Computing Tools	CIV223006C	CIV223007C	Soft Computing Techniques
Planning	CIV223006D	CIV223007D	Town Planning

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

T.Y. B. Tech wef AY 2024-25																	
SEM-VI																	
Course Code	Course Typ	Title of Course	Teaching Scheme			Evaluation Scheme and Marks								Credits			
			TH	TU	PR	INSEM	ENDSEM	CCE	TUT	TW	PR	OR	TOTAL	TH	TU	PR	TOTAL
CIV223011	DCC	Dams and Hydraulic Structures	3	-	-	20	60	20	-	-	-	-	**100**	3	-	-	**3**
CIV223012	DCC	Foundation Engineering	3	-	-	20	60	20	-	-	-	-	**100**	3	-	-	**3**
CIV223013	DCC	Dams and Hydraulic Structures Lab	-	-	2	-	-	-	-	25	-	25	**50**	-	-	1	**1**
CIV223014	DEC	Elective II	3	-	-	20	60	20	-	-	-	-	**100**	3	-	-	**3**
CIV223015	DEC	Elective III	3	-	-	20	60	20	-	-	-	-	**100**	3	-	-	**3**
CIV223016	DEC	Lab work in Elective III	-	-	2	-	-	-	-	25	-	25	**50**	-	-	1	**1**
CIV223017	ESC	Laws for Engineers	3	-	-	20	60	20	-	-	-	-	**100**	3	-	-	**3**
CIV223018	OEC	Sustainable Structures	2	-	-	-	-	50	-	-	-	-	**50**	2	-	-	**2**
CIV223019	ASM	Modern Surveying Techniques	-	1	2	-	-	-	25	-	-	25	**50**	-	1	1	**2**
CIV223020	PSI	Project Phase I	-	-	2	-	-	-		-	-	50	**50**	-	-	1	**1**
Total			**17**	**01**	**08**	**100**	**300**	**150**	**25**	**50**	**-**	**125**	**750**	**17**	**1**	**4**	**22**

Elective Streams	Course Code (TH)	Elective II (SEM VI)
Geotechnical Engg.	CIV223014A	Advanced Geotechnical Engineering
Structural Engg.	CIV223014B	Design of Steel Structures
Coastal Engineering	CIV223014C	Coastal Engineering
Structural Engg.	CIV223014D	Advanced Mechanics of Structures

Elective Streams	Course Code (TH)	Course Code (PR)	Elective III (SEM VI)
QSV	CIV223015A	CIV223016A	Quantity Surveying
Fluid Mechanics	CIV223015B	CIV223016B	Advanced Fluid Mechanics
Computing Tools	CIV223015C	CIV223016C	Data Analytics
Structural Engg.	CIV223015D	CIV223016D	Finite Element Method

SEMESTER V

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223001: Geotechnical Engineering

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week **Practical (CIV223004) :02 hrs/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks** **Term work (CIV223004): 25 Marks** **Oral Exam(CIV223004): 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mathematic, Physics.

Course Objectives:

1) To describe soil properties, classification and its behavior under stress.
2) To learn methods for measurements and determination of index & engineering properties of soil.
3) To study the interaction between water and soil and the effects of static vs flowing water on soil strength

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Identify and classify the soil based on the index properties and its formation process	1. Remember
CO2	Explain permeability and seepage analysis of soil by construction of flow net.	2. Understand
CO3	Illustrate the effect of compaction on soil and understand the basics of stress distribution.	3. Apply
CO4	Express shear strength of soil and its measurement under various drainage conditions.	4. Analyze
CO5	Estimate the earth pressure due to backfill on retaining structures by using different theories.	4. Analyze

COURSE CONTENTS

Unit I	**Introduction and Index Properties**	**(08 hrs.)**	**COs Mapped - CO1**

a) Introduction to Geotechnical Engineering and its applications to Civil Engineering. Types of soil structure, major soil deposits of India, Field identification of soils. Introduction to soil exploration: objective and purpose.
b) Three phase soil system weight – volume relationships, Index properties of soil: Methods of determination and their significance. IS and Unified Soil classification systems.

Unit II	**Permeability and Seepage**	**(07 hrs.)**	**COs Mapped - CO2**

a) Soil water, permeability definition and necessity of its study, Darcy's law, factors affecting permeability. Laboratory measurement of permeability: Constant head method and Falling head method as per IS 2720. Field test for determination of permeability- Pumping in test and Pumping out test as per IS 5529 Part-I. Permeability of stratified soil deposits.
b) Seepage and Seepage Pressure, quick sand phenomenon, critical hydraulic gradient, General flow equation for 2-D flow (Laplace equation). Flow Net, properties and application Flow Net construction for flow under sheet pile and earthen dam.

Unit III	Compaction and Stress Distribution	(07 hrs)	COs Mapped –CO3

a) Compaction – Introduction, Comparison between compaction and consolidation. Compaction tests- Standard Proctor test, Modified Proctor test. Zero air void line. Factors affecting compaction. Effect of compaction on soil properties. Field compaction methods and compaction equipment for different types of soil, Placement water content, Field compaction control- use of compaction test result. Proctor needle in field compaction control.

b) Stress Distribution in Soils – Geostatic stress, Boussinesq's theory with assumptions for point load and circular load (with numerical), Pressure Distribution diagram on a horizontal and vertical plane, Pressure bulb and its significance. Westergaard's theory, equivalent point load method. Approximate stress distribution method.

Unit IV	Shear Strength of Soil	(07 hrs)	COs Mapped - CO4

a) Introduction – Shear strength an Engineering Property. Mohr's stress circle, Mohr- Coulomb failure theory. The effective stress principle- Total stress, effective stress and neutral stress / pore water pressure. Peak and Residual shear strength, factors affecting shear strength. Stress-strain behavior of sands and clays.

b) Measurement of Shear Strength – Direct Shear test, Triaxial Compression test, Unconfined Compression test, Vane Shear test. Their suitability for different types of soils, advantages and disadvantages. Different drainage conditions for shear tests. Sensitivity and thixotropy of cohesive soils.

Unit V	Earth Pressure	(07 hrs)	COs Mapped - CO5

a) Earth Pressure – Introduction, Rankine's state of Plastic Equilibrium in soils- Active and Passive states due to wall movement, Earth Pressure at rest. Rankine's Theory: Earth pressure on Retaining wall due to submerged backfill.

b) Backfill with uniform surcharge, backfill with sloping surface, layered backfill. Coulomb's Wedge theory. Rebhann's and Culmann's graphical method of determination of earth pressure.

Text Books

1. Soil Mechanics and Foundation Engineering by Dr. B. C. Punmia, Laxmi Publications.
2. Geotechnical Engineering by Shashi K. Gulati & Manoj Datta, Tata McGraw Hill.
3. Geotechnical Engineering by T N Ramamurthy & T G Sitharam, S Chand Publications.

Reference Books

1. Principles of Geotechnical Engineering by Braj M.Das, Cengage Learning.
2. Geotechnical Engineering by P Purushothma Raj , Tata McGraw Hill.

Strength of CO-PO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	1	-	-	1	1	1	2	3	3	1	2
CO2	3	2	2	2	1	-	1	1	-	1	2	3	2	2
CO3	3	3	2	2	2	-	1	1	-	-	2	3	2	2
CO4	3	2	2	2	2	-	-	1	-	-	1	3	3	3
CO5	3	2	2	2	1	2	1	1	-	-	2	3	2	2
Average	3	2.2	2	1.9	2.5	2	1	1	1	1.5	2	3	2	2.2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223002: Design of Reinforced Concrete Structures

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week **Practical (CIV223005) :02 hrs/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks** **Term work (CIV223005): 25 Marks** **Oral Exam (CIV223005): 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mechanics, Mechanics of Structures, Structural Analysis

Course Objectives:

1. To provide the students with basic concepts of reinforced concrete structures.
2. To analyze, design and detailing of different component of reinforced concrete structures.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Apply relevant IS provisions to ensure safety and serviceability of structures, understand the design philosophies and behavior of materials: steel & concrete.	3. Apply
CO2	Categorize different cross sections based on modes of failure as per LSM	4. Analyze
CO3	Design & detail rectangular one way and two-way slab with different boundary conditions	5. Evaluate
CO4	Design & detail dog legged and open well staircase	5. Evaluate
CO5	Design & detail singly/doubly rectangular/flanged beams for flexure, shear, bond and torsion.	5. Evaluate
CO6	Design & detail short columns subjected to axial load, uni-axial/bi-axial bending and their footings.	5. Evaluate

COURSE CONTENTS

Unit I	**Design Philosophies and Analysis**	**(08 hrs.)**	**COs Mapped - CO1, CO2.**

Design philosophies of RC structures: working stress method and limit state method, Limit state method: limit state of collapse, limit state of serviceability and limit state of durability, characteristic strength, characteristic load, partial safety factors. structural properties of concrete and reinforcing steel, assumptions of limit state method, strain variation diagram, stress variation diagram, design parameters for singly reinforced rectangular section, modes of failure, moment of resistance of singly and doubly reinforced rectangular section, singly reinforced flanged section.

Unit II	**Design of Slab**	**(07 hrs.)**	**COs Mapped - CO1, CO3**

Design of one-way slab: simply supported, cantilever and continuous slabs by using IS Code coefficients, design of two way slab: simply supported, continuous and restrained.

UnitIII	**Design of Staircase and Beams**	**(07 hrs.)**	**COs Mapped -CO1, CO4**

Design of staircase: dog legged and open well, design of simply supported, cantilever beams for flexure (singly reinforced, doubly reinforced and flanged), shear, bond and torsion.

Unit IV	**Design of Beams**	**(07 hrs)**	**COs Mapped – CO1, CO5**
Design of rectangular and flanged cross section continuous beam by using IS code coefficients and moment redistribution method.			
Unit V	**Design of Column & Footing**	**(07 hrs)**	**COs Mapped – Co1, CO6**
Assumptions, minimum eccentricity, design of short column for axial load, design of short column subjected to combined axial load and uni-axial/biaxial bending using interaction curves. Design of isolated column footing for axial load, uni-axial bending and bi-axial bending			

Text Books

1. Illustrated Reinforced Concrete Design, Dr. V. L. Shah and Dr. S. R. Karve, Structures Publications, Pune
2. Limit State Design of Reinforced Concrete, P. C. Varghese, PHI, New Delhi.

Reference Books

1. Illustrated Design of Reinforced Concrete Buildings (G+3), Dr. V. L. Shah and Dr. S. R. Karve, Structures Publications, Pune.
2. Design of Reinforced Concrete Structures, N. Subramanian, Oxford University Press.
3. Limit State Analysis and Design, P. Dayaratnram, Wheeler Publishing Company.
4. Comprehensive Design of R.C. Structures, Punmia, Jain and Jain, Standard Book House, New Delhi.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	3	3	-	3	-	3	-	3	3	1
CO2	3	3	3	3	3	3	-	2	-	-	-	3	3	2
CO3	3	3	3	3	3	3	-	2	2	3	-	3	3	2
CO4	3	3	3	3	3	3	-	2	2	3	-	3	3	2
CO5	3	3	3	3	3	3	-	2	2	3	-	3	3	2
Average	**2.8**	**3.0**	**3.0**	**2.8**	**3.0**	**3.0**	**-**	**2.2**	**2.0**	**3.0**	**-**	**3.0**	**3.0**	**1.8**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Three assignments (Analysis of single reinforced, doubly reinforced and flanged section, One way continuous slab, design of one structural element using spreadsheet/ programming	15
2	LMS tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: V (B Tech Civil Engineering)
CIV223003: Hydrology and Water Resources Engineering

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory : 03 hrs / week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **Insem Exam: 20Marks** **End sem Exam: 60Marks**

Prerequisite Courses, if any: - Differential Equations, Physics, Environmental Science.

Course Objectives:

1. To introduce students with applications of different software in Hydrology and different government organizations.
2. To apply knowledge the different aspects of hydrology such as precipitation, evaporation, infiltration runoff, hydrographs and streams gauging, mass curve and demand curve in field work and projects.
3. To use the concept of reservoir planning and capacity of reservoir in field projects. To provide the exposure for analysis of ground water hydrology and well hydraulics.
4. To apply knowledge of crop water requirement in design of canal

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Learners will be able to know applications of different software in Hydrology and different government organizations.	1-Knowledge 2- Understand
CO2	Learners will be able to apply knowledge the different aspects of hydrology in field work and projects.	2- Understand 3-Apply
CO3	Learners will be able to apply concept of mass curve in reservoir planning	2- Understand 3-Apply
CO4	Learners will be able to do analysis of ground water and well hydraulics.	4- Analysis
CO5	Learners will be able to apply knowledge irrigation and crop water requirement in design of canal	3-Apply

COURSE CONTENTS

Unit I	**INTRODUCTION TO HYDROLOGY**	**(08 hrs)**	**COs Mapped - CO1, CO2**

Introduction to applications of different software in Hydrology, Introduction to different government organizations such as IMD, CWPRS, MERI, CDO, Hydrology Project Division, NIH, CWC.

Hydrological cycle , Precipitation: Types & forms of precipitation, precipitation measurement, rain gauge network, presentation of rainfall data, mass rainfall curves, hyetograph, mean precipitation over an area, field applications of …. Arithmetic mean method, Thiessen's polygon, isohyet method, frequency analysis, frequency of point rainfall, intensity-duration curves, maximum intensity-duration.

Evaporation- elementary concepts, factors affecting, measurement of evaporation, transpiration, field applications

Evapotranspiration, modified Penman method,- process and measurement

Infiltration: introduction, infiltration capacity, infiltrometer, field applications of Horton's method and infiltration indices.

Unit II	**RUNOFF**	**(07 hrs)**	**COs Mapped - CO2**

Introduction, factors affecting runoff, rainfall-runoff relationships and empirical techniques to determine runoff

Runoff hydrograph: Introduction, factors affecting flood hydrograph, components of hydrograph, base flow separation, effective rainfall

Unit hydrograph theory, development of unit hydrograph uses and limitations of unit hydrograph

Stream gauging: selection of site, discharge measurement by velocity-area method, introduction to advance techniques/equipment used in gauge discharge measurements such as radar, current meter, ADCP (Acoustic Doppler current profiler).

Unit III	**RESERVOIR PLANNING**	**(07 hrs)**	**COs Mapped – CO3**

Reservoir Planning Introduction, term related to reservoir planning (yield, reservoir planning and operation curves, reservoir storage, reservoir clearance), investigation for reservoir planning.

Significance of mass curve and demand curves, applications of mass curve and demand curves.

Reservoir sedimentation- Phenomenon, measures to control reservoir sedimentation, density currents Significance of trap efficiency, useful life of reservoir.

Unit IV	**GROUND WATER HYDROLOGY**	**(07 hrs)**	**COs Mapped – CO4**

Occurrence and distribution of ground water, specific yield of aquifers, movement of ground water, **Darcy's law**, permeability, safe yield of basin, hydraulics of wells under steady flow condition in confined and unconfined aquifers, specific capacity of well

Tube wells, Open wells and their construction

Water logging and Drainage: Causes of water logging, effects of water logging, preventive and curative measures of water logging

Land drainage, reclamation of water logged areas, alkaline and saline lands

Unit V	**ITODUCTION TO IRRIGATION**	**(07 hrs)**	**COs Mapped – CO5**

Introduction to irrigation, functions, advantages and necessity, methods of irrigation, surface irrigation, subsurface irrigation, micro-irrigation,

Water requirements of crops: Soil moisture and crop water relationship, consumptive use of water, principal Indian crops, crop seasons, crop water requirement: crop planning, agricultural practices.
Duty, delta, irrigation efficiency and its application in design of Canal.

Piped distribution network for irrigation (PDN), Introduction, advantages and disadvantages of PDN

Text Books

1. Engineering Hydrology, K. Subramanyam, Tata McGraw Hill.
2. Hydrology and Water Resources Engineering, Vol-1, Garg, S. K. , Khanna Publishers, New Delhi
3. Irrigation, Water Resources and Water Power Engineering, Modi, P. N. ,Standard Book

Reference Books

1. A Textbook of Hydrology, P. Jaya Rami Reddy, USP Publisher.
2. Irrigation and Water power Engineering, Punmia B.C. and Pande K.Lal, Standard Publisher
3. Irrigation Engineering, Bharat Singh, Nem Chand ,India
4. Irrigation Engineering, Raghunath, H. M. , Wiley

Strength of CO-PO Mapping												
	PO											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	3	-	-	-	3	-				-	1	2
CO2	3	3	3	-	2	2	2	-	-	-	2	2
CO3	3	3	3	-	2	2	2	-	-	-	2	2
CO4	3	3	3	-	2	2	2	-	-	-	2	2
CO5	3	2	3	2	2	2	2	1	1	-	2	2
Average	3	2.27	3	2	2.2	2	2	1	1	-	1.8	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	**2 Assignments on Unit-1** i) Marking catchment area on a toposheet and working out average annual precipitation and determining yield by various methods ii) Applications of different software in Hydrology and Water Resources Engineering **1 Assignment on Unit-5** : i) Design of Canal	5 5
2	LMS tests on each unit	10
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223004: Geotechnical Engineering Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term work : 25 Marks** **Oral Exam: 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mathematic, Physics.

Course Objectives:

1. Recall and describe fundamental principles of soil mechanics.
2. Identify different types of soil samples and their properties.
3. Explain the behavior of soils under various loading conditions.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Proficiently use laboratory equipment and techniques to perform various soil tests.	1. Remember
CO2	Interpret and analyze data obtained from laboratory tests to determine important soil properties.	`2. Understand
CO3	Apply principles of soil mechanics to understand the behavior of soils under different loading conditions.	3.Apply
CO4	Evaluate the suitability of soils for various engineering applications based on laboratory test results.	5. Evaluate

List of Laboratory Experiments / Assignments
(Any Ten)

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Water content determination by any two methods a) Oven drying method, b) Infrared moisture method, c) calcium carbide method	**CO1,CO2**
2	Specific gravity determination by Pycnometer /density bottle.	**CO1,CO2**
3	Sieve analysis, particle size determination and IS classification as per I.S. Codes.	**CO1,CO2,CO4**
4	Determination of Consistency limits and their use in soil classification as per I.S. Codes.	**CO1,CO2,CO4**
5	Field density test by a) Core cutter b) Sand Replacement and c) Clod method	**CO1,CO2,CO4**
6	Determination of coefficient of permeability by a) Constant head and b) Variable head method.	**CO1,CO2,CO4**
7	Direct shear test.	**CO1,CO2,CO3**
8	Unconfined compression test.	**CO1,CO2,CO3**
9	Vane Shear test.	**CO1,CO2,CO3**
10	Triaxial test	**CO1,CO2,CO3**

11	Standard Proctor test / Modified Proctor test.	**CO1,CO2,C**
12	Differential free swell test.	**CO1,CO2**

Guidelines for Laboratory Conduction
1. Teacher will brief the given experiment to students its procedure, tools, and outcome of the practical. 2. Computers and software required for the allotted experiment will be provided by the lab assistants using SOP. 3. Students will perform the allotted practical individually under the supervision of faculty and lab assistant. 4. After performing the practical students will check their images/processing from the teacher. 5. After checking they have to write the outcome of the practical.
Guidelines for Student's Lab Journal
Write-up should include title, aim, diagram, procedure, tools, graphs, symbols, images and questions, if any.
Guidelines for Termwork Assessment
1. Each experiment from lab journal is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

Strength of CO-PO Mapping														
	PO												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	1	-	-	-	-	-	-	3	3	-	3	1	-
CO2	3	1	-	-	-	-	-	-	3	3	-	3	1	-
CO3	3	1	-	-	-	-	-	-	3	3	-	3	1	-
CO4	3	1	-	-	-	-	-	-	3	3	-	3	1	-
Average	3	1	-	-	-	-	-	-	3	3	-	3	1	-

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223005: Design of Reinforced Concrete Structures Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term work : 25 Marks** **Oral: 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mechanics, Mechanics of Structures, Structural Analysis

Course Objectives:

1 To provide the students with basic concepts of reinforced concrete structures.
2 To analyze, design and detailing of different component of reinforced concrete structures.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Apply relevant IS provisions to ensure safety and serviceability of structures, understand the design philosophies and behavior of materials: steel & concrete.	4. Apply
CO2	Categorize different cross sections based on modes of failure as per LSM	5. Analyze
CO3	Design & detail rectangular one way and two-way slab with different boundary conditions	6. Evaluate
CO4	Design & detail dog legged and open well staircase	6. Evaluate
CO5	Design & detail singly/doubly rectangular/flanged beams for flexure, shear, bond and torsion.	5. Evaluate
CO6	Design & detail short columns subjected to axial load, uni-axial/bi-axial bending and their footings.	5. Evaluate

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Design Project: Design of G + 2 (residential/commercial/public) building covering all types of slabs, beams, columns, footings and staircase (first and intermediate flight) with following details. i. Minimum plan area of each floor shall be more than 150 m^2 ii. Design of plinth and ground beams: for each type two simply supported and two continuous. iii. Design of all slabs and beams of typical floor (first or second floor) iv. Design of three types of columns: (a) axial load, (b) axial load with uniaxial bending, (c) axial load with biaxial bending, from terrace level to footing along with detailed load calculations. v. Design of two footing: (a) axial load, (b) axial load plus uniaxial bending. vi. Design any one element by using spread sheet or use of analysis and design by suitable software. vii. Four full imperial drawing sheets. Out of which only structural plan drawing sheet shall be drawn by using any drafting software. Schedule of slabs, beams, columns and footing can be prepared by using any drafting software. viii. Detailing of reinforcement should be as per SP-34 & IS-13920.	
2	Two assignments on design of combined footing along with reinforcement detailing	

3	Reports of two site visits. (Building under construction)	

Guidelines for Termwork Assessment
1. Each assignment is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journalwriting where each rubric carries ten marks.

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223006 A: Advanced Concrete Technology

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week **Practical (CIV223007 A) :02 hrs/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks** **Term work (CIV223007 A): 25 Marks** **Oral Exam (CIV223007 A): 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mathematic, Concrete Technology.

Course Objectives:

6. To provide an advanced understanding on cement chemistry, influence of supplementary cementitious materials, and effect of admixtures on properties of concrete
7. To illustrate the role of fibers and understand the durability properties of concrete
8. To study advanced testing methods on concrete

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Apply the knowledge of supplementary cementitious materials to produce sustainable concretes.	3-Apply
CO2	Understand the mechanism of working of admixtures and their effect on properties of concrete.	1-Remember
CO3	Evaluate the characteristic properties of fiber reinforced concrete.	4-Analyze
CO4	Understand the durability properties of concrete.	2-Understand
CO5	Interpret the properties of concrete through advance testing methods.	4-Analyze

COURSE CONTENTS

Unit I	**Supplementary Cementitious Materials**	**(08 hrs.)**	**COs Mapped - CO1, CO2.**

Fly ash, blast furnace slag, silica fume, rice husk ash, metakaolin, industrial waste or by-products, chemical composition and classification, effect on hydration process of portland cement, effect on workability of concrete, effect on the properties of hardened concrete, effect on durability of concrete.

Unit II	**Chemical Admixtures**	**(07 hrs.)**	**COs Mapped - CO1, CO2.**

Classification of admixtures, chemistry and mechanism, effect of admixtures on plastic properties and hardened properties of concrete, applications, specialty admixtures - viscosity modifying admixtures, corrosion-inhibiting admixtures, shrinkage-reducing admixtures.

Unit III	**Fiber Reinforced Concrete**	**(07 hrs)**	**COs Mapped - CO3.**

Types of fibers, matrix, stress transfer mechanism, steel fiber reinforced concrete (SFRC) – types of steel fibers, balling effect, effect on properties of hardened concrete, applications, slurry infiltrated fiber concrete (SIFCON) - fresh and hardened properties of SIFCON, applications, synthetic fiber reinforced concrete – types of synthetic fibers, properties of fibers, effect of fibers on properties of concrete, applications.

Unit IV	Durability of Concrete	(07 hrs)	COs Mapped - CO4.
Plastic shrinkage, autogenous shrinkage, drying shrinkage, mitigation strategies, transport properties of concrete, permeability, corrosion, chloride penetration, carbonation, sulphate attack and acid attack.			
Unit V	**Testing of Concrete**	**(07 hrs)**	**COs Mapped - CO5.**
Ultrasonic pulse velocity method: theory of pulse propagation through concrete, interpretation of results, corrosion: half-cell potential measurement, electrical resistivity method, permeability and absorption tests, concrete cores – core location and size, drilling, testing and interpretation of results, in-situ load testing.			

Text Books

1 Concrete Technology, A.R. Santhakumar, Oxford University Press
2 Concrete Technology, Job Thomas, Cengage Publications

Reference Books

1 Properties of Concrete, A. M. Neville, Pearson Education
2 Concrete: Microstructure, Properties, and Materials, P. Kumar Mehta and Paulo J.M. Monteiro, McGraw Hill Education

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	-	-	3	-	2	-	-	-	-	3	-	-
CO2	3	3	-	-	3	-	2	-	-	-	-	3	-	-
CO3	3	3	-	2	3	-	2	-	-	-	-	3	3	2
CO4	3	3	3	-	3	3	2	-	-	2	-	3	2	-
CO5	3	3	2	2	3	2	2	-	-	-	-	3	2	-
Average	3	3	2.5	2	3	2.5	2	-	-	2	-	3	2.7	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223006 B: Operation Research

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week **Practical(CIV223007B) :02 hrs/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks** **Term work(CIV223007B) :25 Marks** **Oral Exam(CIV223007B): 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mathematic

Course Objectives:

1. Engineers with the ability to analyze the data for a given problem and formulate mathematical models.
2. Engineers with ability to optimize linear & non-linear programming problems.
3. Engineers with the ability to apply the knowledge for optimization for Civil Engineering Projects

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand the fundamental concepts of operations research and its applications in civil engineering.	1- Understand
CO2	Illustrate Sequencing strategies and Monte Carlo simulation techniques to model and analyze stochastic processes	2-Understand
CO3	Interpret appropriate Nonlinear programming techniques to obtain optimum solution	2-Understand
CO4	Apply the simplex method to solve linear programming problems by iteratively improving feasible solutions towards optimality.	3-Apply
CO5	Calculate the Optimum cost for various resources using Transportation and Assignment Model	4.Analyze

COURSE CONTENTS

Unit I	**Introduction of Operations Research, Replacement Model**	**(08 hrs.)**	**COs Mapped - CO1**
Introduction to operations research and optimization techniques, applications of operations research in civil engineering, introduction to linear and non-linear programming methods, formulation of linear optimization models for civil engineering applications (objective function, constraints), graphical solutions to L P problems, local & global optima, unimodal function, convex and concave function. Replacement of items whose maintenance and repair cost increase with time ignoring time value of money			
Unit II	**Stochastic Programming**	**(07 hrs.)**	**COs Mapped - CO2**
Sequencing: n jobs through 2, 3 and M machines, Simulation: Monte Carlo simulation.			
Unit III	**Linear programming (A)**	**(07 hrs)**	**COs Mapped –CO5**
The transportation model and its variants, assignment model and its variants,			
Unit IV	**Linear programming(B)**	**(07 hrs)**	**COs Mapped - CO4.**

The simplex method, method of big M and two-phase method			
Unit V	**Nonlinear programming**	**(07 hrs)**	**COs Mapped - CO3**
Single variable unconstrained optimization: sequential search techniques-dichotomous, Fibonacci, golden section, multivariable optimization without constraints: the gradient vector and hessian matrix, gradient techniques, steepest ascent/decent technique, Multivariable optimization with equality constraints: Lagrange multiplier technique			

Text Books

1. Operations Research by Premkumar Gupta and D.S.Hira, S. Chand Publications (2014).
2. Engineering Optimization: Methods and Application-- A. Ravindran, K. M. Ragsdell—Wiley India.
3. Engineering Optimization by S. S. Rao.
4. Operations Research by Hamdy A. Taha.
5. Quantitative Techniques in Management by N.D. Vohra (Mc Graw Hill) .
6. Operations Research by Pannerselvam, PHI publications.

Reference Books

1.Topics in Management Science by Robert E. Markland(Wiley Publication).
2. An Approach to Teaching Civil Engineering System by Paul J. Ossenbruggen.
3. A System Approach to Civil Engineering Planning & Design by Thomas K. Jewell (Harper Row Publishers).

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	--	--	1	--	--	--	--	--	--	1	1	--	--
CO2	1	2	1	1	1	1	--	--	--	--	2	1	--	1
CO3	2	1	--	1	1	--	--	--	--	1	1	1	--	1
CO4	2	1	1	2	--	--	--	--	1	1	2	1	--	1
CO5	2	1	--	1	1	--	--	--	--	1	1	1	--	1
Average	1.6	1.2	1.0	1.3	1.0	1.0	--	--	1.0	1.0	1.5	1.0	--	1.0

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223006 C: Soft Computing Techniques

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week **Practical (CIV223007 C) :02 hrs/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks** **Term work (CIV223007C): 25 Marks** **Oral Exam (CIV223007C): 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of spreadsheet, Python.

Course Objectives:

1 To understand the practical applications of soft computing techniques, specifically using Python and Spreadsheet, in solving various problems encountered in Civil Engineering.
2 To gain proficiency in utilizing soft computing tools for optimization, data analysis, and decision-making processes within the context of Civil Engineering.
3 To apply soft computing methodologies in real-world scenarios, such as structural analysis, infrastructure management, through hands-on exercises.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Learn the syntax and semantics of Python Programming Language.	1-Remember
CO2	Write Python functions to facilitate code reuse and manipulate strings.	1-Remember
CO3	Illustrate the process of structuring the data using lists, tuples and dictionaries.	2-Understand
CO4	Demonstrate comprehension of spreadsheet by applying basic functions and formulas relevant to civil engineering calculations and data analysis.	2-Understand
CO5	Interpret and analyze data effectively using Microsoft Excel, employing features like sorting, filtering, and conditional formatting to organize and visualize information for tasks	3-Apply

COURSE CONTENTS

Unit I	**Python Basics**	**(08 hrs.)**	**COs Mapped - CO1, CO2.**

Entering expressions into the interactive shell, integer, floating-point, and string data types, string concatenation and replication, storing values in variables, boolean values, comparison operators, boolean operators, mixing boolean and comparison operators.

Unit II	**Strings and Functions**	**(07 hrs.)**	**COs Mapped - CO1, CO2, CO3.**

'def' Statements with Parameters, Return Values and 'return' Statements, The None Value, Keyword Arguments and 'print()', local and global scope, the global statement, exception handling, the list and tuples data type, working with lists and tuples.

Unit III	**Lists, Tuples and Dictionaries**	**(07 hrs)**	**COs Mapped - CO1, CO2, CO3**

The dictionary data type, using data structures to model real-world things, working with strings, useful string methods, applications of python in civil engineering.

Unit IV	Spreadsheet, Excel Functions and Macros	(07 hrs)	COs Mapped - CO4, CO5.
Worksheet and Workbook, Data Type, Formula, Built-In Function, Data Formatting, Making Charts , Math and Trigonometry Functions, Logical Functions, Lookup Functions, Text Functions, Data Analysis Functions, Creating macros, Function Procedure, Control Structures, User Defined Function Problems, Chart Macro.			
Unit V	**Application to Civil Engineering**	**(07 hrs)**	**COs Mapped - CO4, CO5.**
Python and Excel programs: Matrix Method for Structural Analysis, numerical methods, 2d truss structure analysis, beam on elastic foundation, one dimensional consolidation, applications in transportation engineering.			

Text Books

1 Al Sweigart, “Automate the Boring Stuff with Python”, William Pollock.
2 Allen B. Downey, "Think Python: How to Think Like a Computer Scientist”, Green Tea Press.

Reference Books

1. ReemaThareja, “Python Programming using problem solving approach”, Oxford University press.
2. An Introduction to EXCEL for Civil Engineers, Gunthar Pangaribuan.

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	-	-	3	-	2	-	-	-	-	3	-	-
CO2	3	3	-	-	3	-	2	-	-	-	-	3	-	-
CO3	3	3	-	2	3	-	2	-	-	-	-	3	3	2
CO4	3	3	3	-	3	3	2	-	-	2	-	3	2	-
CO5	3	3	2	2	3	2	2	-	-	-	-	3	2	-
Average	3	3	2.5	2	3	2.5	2	-	-	2	-	3	2.7	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223006 D: Town Planning

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week **Practical(CIV223007D): 02 hrs/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20Marks** **In-Sem Exam: 20Marks** **End-Sem Exam: 60Marks** **Term work(CIV223007D): 25 Marks** **Oral Exam(CIV223007D): 25 Marks**

Prerequisite Courses, if any: - Fundamentals of Building Technology and Architectural Planning

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	To Understand principles of architectural planning, futuristic need of users and discuss the concepts of Urban renewal and sustainable architecture	2-Understand
CO2	To interpret need of civic surveys for DP proposal and value planning agencies and ITS	3-Apply
CO3	To demonstrate planning strategy with reference to different acts, guidelines, norms.	3-Apply
CO4	To distinguish and relate planning levels and understand use of act and to develop neighborhood plan	4- Analyze
CO5	To appraise multifaceted zones like SEZ, CRZ and Special township, understand applications of modern Tools like GIS / GPS / RS in town planning and need of Rural Planning	5-Evaluate

COURSE CONTENTS

Unit I	**Architecture and Urban Planning**	**(08 hrs)**	**COs Mapped – CO2**

Principles and elements of architectural composition and its expected outcome, qualities of architecture: user friendly, contextual, eco-friendly, utility of spaces, future growth etc. with case study. Role of urban planner and an architect in planning and designing in relation with spatial organization, utility, demand of the area and supply etc considering situations like disasters / pandemic conditions. Urban renewal process and its impact on quality of life and livability, importance of sustainable architecture, urban conservation with case study.

Unit II	**Town Planning and Policies in India and Maharashtra**	**(07 hrs)**	**COs Mapped – CO3**

Scope, purpose and benefits of town planning, components of town planning, planning levels: regional plan, development plan, town planning scheme, neighborhood planning, new towns and satellite towns, legislative mechanism for preparation of DP: MRTP Act 1966,

Policies in India and Maharashtra: National Urban Transport Policy, National Land-utilization policy, National Housing Policy. Planning agencies for various levels of planning and the organizational details with purpose (CIDCO, MHADA, MIDC, MMRDA/PMRDA, SRA and HUDCO),

Unit III	**Civic Survey and Valuation**	**(07 hrs)**	**COs Mapped – CO3**

Civic surveys and its utility for DP proposal: like demographic, housing, land use, water supply and sanitation. Traffic transportation systems: hierarchy of roads, traffic management, intelligent transport systems.
Valuation: Special Characteristics of Landed Property, Supply and Demand of Landed Property, forms of value and rent etc

Unit IV	Acts and Guidelines	(07 hrs)	COs Mapped – CO4

Land acquisition rehabilitation and resettlement Act, 2013, real estate (regulation and development) act 2016 and MAHA-RERA, Right to Information Act. Right to Service Act, 73rd and 74th Constitutional Amendment Act.
URDPFI Guidelines (for land use, infrastructure etc.), AMRUT Guidelines (water/sewerage, transport etc.),

Unit V	Special Township and Current events and Technologies	(07 hrs)	COs Mapped – CO5

Special townships: SEZ and CRZ,
Application of GIS, GPS, remote sensing, Drones in Town planning,
Rural planning: need, strategies, government initiatives

Text Books

1. Town Planning, G. K. Hiraskar, Dhanpat Rai Publications
2. Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.

Reference Books

1. MRTP Act 1966 : The director, government printing, stationary and publications, Maharashtra state, Mumbai
2. URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India
3. LARR Act 2013: Ministry of law and justice, Government of India

	Strength of CO-PO/PSO Mapping													
	PO												PSO	
CO 1	1	1	2	1	-	2	1	1	-	-	-	1	-	-
CO 2	-	-	-	-	1	2	1	2	1	1	1	-	-	-
CO 3	-	-	-	1	3	1	3	1	2	2	1	2	2	-
CO 4	-	-	-	1	1	2	2	2	2	2	2	2	2	1
CO 5	2	1	2	-	-	2	-	2	1	1	1	1	2	-
Average	2	1	2	1	1	2	2	2	2	2	1	2	2	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments on Unit-1 to Unit-4.	15
3	LMS tests on each unit	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223007 A: Advanced Concrete Technology Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term work : 25 Marks** **Oral Exam : 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mathematic, Concrete Technology.

Course Objectives:

1.To provide an advanced understanding on cement chemistry, influence of supplementary cementitious materials, and effect of admixtures on properties of concrete
2.To illustrate the role of fibers and understand the durability properties of concrete
3.To study advanced testing methods on concrete.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Apply the knowledge of supplementary cementitious materials to produce sustainable concretes.	3-Apply
CO2	Understand the mechanism of working of admixtures and their effect on properties of concrete.	1-Remember
CO3	Evaluate the characteristic properties of fiber reinforced concrete.	4-Analyze
CO4	Understand the durability properties of concrete.	2-Understand
CO5	Interpret the properties of concrete through advance testing methods.	4-Analyze

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Shrinkage test on cement / concrete: Determine the drying shrinkage of cement/concrete in accordance to IS 1199	**CO3**
2	Permeability test on concrete: Determine the permeability of concrete in accordance to IS 3085	**CO3**
3	Flexure test on fiber reinforced concrete beams: Determine the improvement in toughness of concrete containing fibers (any type of fiber).	**CO2, CO4**
4	Optimum dosage of admixture using Marsh cone apparatus: Determine the optimum dosage of plasticizers and superplasticizers for different types of cement.	**CO4**
5	Test on chloride penetration in concrete: Determine the chloride content in hardened mortar / concrete in accordance to IS: 14959 (Part 2).	**CO2**
6	Elastic modulus of concrete: Determine the elastic modulus of concrete in accordance to IS: 516.	**CO3**
7	NDT on concrete: Perform NDT on concrete using ultrasonic pulse velocity method.	**CO4**

Guidelines for Laboratory Conduction
1. Teacher will brief the given experiment to students its procedure, tools, and outcome of the practical. 2. Computers and software required for the allotted experiment will be provided by the lab assistants using SOP. 3. Students will perform the allotted practical individually under the supervision of faculty and lab assistant. 4. After performing the practical students will check their images/processing from the teacher. 5. After checking they have to write the outcome of the practical.
Guidelines for Student's Lab Journal
Write-up should include title, aim, diagram, procedure, tools, graphs, symbols, images and questions, if any.
Guidelines for Termwork Assessment
1. Each experiment from lab journal is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223007B: Operation Research Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs./week	**01**	**Term work: 25 Marks** **Oral Exam:25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mathematic

Course Objectives:

1. Engineers with the ability to analyze the data for a given problem and formulate mathematical models.
2. Engineers with ability to optimize linear & non-linear programming problems.
3. Engineers with the ability to apply the knowledge for optimization for Civil Engineering Projects

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand the Application of each method and able to solve using Software	2. Understand
CO2	solve optimization problems and analyze results, enhancing their technical skills and ability to implement solutions efficiently	3.Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	One exercise/assignment on each unit	**CO1**
2	Out of this any one exercise/assignment to be solved using Computer programming/ Software	**CO2**
3	One exercise on formulation of a problem applicable to any field of Civil Engineering, requiring use of LP/ NLP/ DP. Formulation of objective function and constraints (No solution)	**CO2**
4	One exercise on analysis and solution using any of the above methods for data collected from Government Sources.	**CO2**

Guidelines for Laboratory Conduction

1. Teacher will brief the given experiment to students its procedure, tools, and outcome of the practical.
2. Computers and software required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will perform the allotted practical individually under the supervision of faculty and lab assistant.
4. After performing the practical students will check their images/processing from the teacher.
5. After checking they have to write the outcome of the practical.

Guidelines for Student's Lab Journal

Write-up should include title, aim, diagram, procedure, tools, graphs, symbols, images and questions, if any.

Guidelines for Termwork Assessment
1. Each experiment from lab journal is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223007 C: Soft Computing Techniques Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term work :25 Marks** **Oral Exam :25 Marks**

Prerequisite Courses, if any: - The basic knowledge of spreadsheet, Python.

Course Objectives:

1. To understand the practical applications of soft computing techniques, specifically using Python and Spreadsheet, in solving various problems encountered in Civil Engineering.
2. To gain proficiency in utilizing soft computing tools for optimization, data analysis, and decision-making processes within the context of Civil Engineering.
3. To apply soft computing methodologies in real-world scenarios, such as structural analysis, infrastructure management, through hands-on exercises.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Implement soft computing techniques using Python for data analysis and optimization in civil engineering problems.	1. Remember
CO2	Design and implement simulation models for civil engineering systems using Python libraries and Excel functionalities	3. Apply
CO3	Demonstrate proficiency in utilizing advanced spreadsheet functions in Excel for modeling and analyzing civil engineering data.	3.Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Application of python and excel for Hydrology and Water Resource Engineering	**CO1,CO2,CO3**
2	Application of python and excel for Concrete Technology	**CO1,CO2,CO3**
3	Application of python and for Mechanics of Structures	**CO1,CO2,CO3**
4	Application of python and excel for Engineering Mechanics	**CO1,CO2,CO3**
5	Application of python and excel for Soil Mechanics	**CO1,CO2,CO3**

Guidelines for Laboratory Conduction
1. Teacher will brief the given experiment to students its procedure, tools, and outcome of the practical. 2. Computers and software required for the allotted experiment will be provided by the lab assistants using SOP. 3. Students will perform the allotted practical individually under the supervision of faculty and lab assistant. 4. After checking they have to write the outcome of the practical.
Guidelines for Student's Lab Journal
Write-up should include title, aim, numerical and code.
Guidelines for Termwork Assessment
1. Each experiment from lab journal is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

T. Y. B. Tech. **Pattern 2022 Semester: V (B. Tech Civil Engineering)** **CIV223007 D: Town Planning Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 02 hrs/week	**01**	**Term work: 25Marks** **Oral Exam: 25 Marks**
Prerequisite Courses, if any: - Fundamentals of Building Technology and Architectural Planning		
Course Outcomes: On completion of the course, students will be able to–		

	Course Outcomes	**Bloom's Level**
CO1	To Understand principles of architectural planning, futuristic need of users and discuss THE urban renewal and sustainable architecture	2-Understand
CO2	To interpret need of civic surveys for DP proposal and value planning agencies and ITS	3-Apply
CO3	To demonstrate planning strategy with reference to different acts, guidelines, norms.	3-Apply
CO4	To distinguish and relate planning levels and understand use of act and to develop neighborhood plan	4- Analyze
CO5	To appraise multifaceted zones like SEZ, CRZ and Special township, understand applications of modern Tools like GIS / GPS / RS in town planning and need of Rural Planning	5-Evaluate

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Report on contribution of engineers, planners and architects in post-independence India (Individual work)	**CO1**
2	Study and analysis of Development Plan (DP) with respect to land use, services, infrastructure, street furniture, housing etc. (Group work)	**CO2**
3	Study of salient features of urban renewal schemes (Group work)	**CO1**
4	Study of any existing town planning scheme (Group work)	**CO3**
5	Report on any existing new towns or planned towns or satellite towns like new Mumbai, Gandhinagar etc. (in relation with TP aspects inclusive of infrastructure, disaster management etc), (Individual work)	**CO1**
6	Study of URDPFI/AMRUT/ UDCPR or URDPFI guidelines with a case study (Individual work)	**CO3**
7	Study of special townships or SEZ or CRZ or rural planning strategies (Group work)	**CO5**
8	Report on Rural Planning (Individual Work)	**CO5**
9	Report on LARR/ 73rd and 74th Amendment Act/ MRTP Act (Individual Work)	**CO3,**
10	Report on Use of New technologies in Town planning like: Drones, GIs, GPS (Individual Work)	**CO5**

Guidelines for Laboratory Conduction
1. Teacher will brief the given assignment to students along with its procedure, tools, and outcome. 2. Students will perform the allotted practical individually under the supervision of faculty. 3. After performing the practical students will check their reports from the teacher on given time.
Guidelines for Student's Lab Sheets
Sheets must be neat and clean. Every information in sheet should be filled properly. (like- name of sheet, scale, name of student, etc.)
Guidelines for Termwork Assessment
1. Each experiment from given syllabus is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for Timely Completion, R-2 for Understanding and R-3 for Presentation/sheets drawing where each rubric carries Ten marks.

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223008: Safety Management

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :02 hrs/week	**02**	**Continuous Comprehensive Evaluation: 50 Marks**

Prerequisite Courses, if any: - Project planning and execution.

Course Objectives:

1. Understand the principles of safety management and its role in preventing accidents and injuries.
2. Learn about safety laws and regulations, and the role of regulatory bodies in safety management.
3. Identify hazards and assess risks using various techniques.
4. Understand the process of conducting safety audits and inspections.
5. Learn about different types of safety equipment and Personal Protective Equipment (PPE), and their proper use and maintenance.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	To understand the basic principles of safety management and its role in various industries.	Understand
CO2	To describe the purpose and importance of safety laws and regulations, and the rights and responsibilities of employers and employees	Understand
CO3	To identify different types of PPE, and explain their proper use, maintenance, storage, and replacement.	Understand
CO4	To apply techniques for hazard identification and risk assessment methods to develop safety measures.	Apply
CO5	To conduct a safety audit, interpret audit results, and identify areas of non-compliance and potential safety hazards. .	Apply

COURSE CONTENTS

Unit I	**Introduction to Safety Management**	**(05 hrs.)**	**COs Mapped - CO1**

Definition of safety management, its role in preventing accidents and injuries , Basic principles of safety management: commitment from leadership, employee involvement, hazard identification and control, education and training, and continuous improvement ,Role of safety management in various industries.

Unit II	**Safety Laws and Regulations**	**(05 hrs.)**	**COs Mapped - CO2**

Overview of safety laws and regulations : concept, purpose and importance of safety laws and regulations , Occupational Safety and Health Act (OSHA): history, purpose, and key provisions, rights and responsibilities of employers and employees, Role of regulatory bodies in safety management

Unit III	**Hazard Identification and Risk Assessment**	**(05 hrs.)**	**COs Mapped - CO3**

Hazard identification , its importance in safety management, Techniques for hazard identification : job safety analysis (JSA), hazard and operability study (HAZOP), and checklist method , Risk assessment methods : qualitative (risk matrix, expert judgment) and quantitative (sensitivity analysis, expected

monetary value analysis) , Development of safety measures based on risk assessment : types of safety measures such as engineering controls, administrative controls, and personal protective equipment (PPE).

Unit IV	Safety Audits and Inspections	(05 hrs.)	COs Mapped - CO4

Role of safety audits and inspections: purpose and importance , difference between safety audits and inspections, Conducting effective safety audits : process of conducting safety audit, including planning, conducting, reporting, and follow-up, role of the auditor, the preparation required, and the key areas to focus on during an audit. Understanding and interpreting audit results: audit scores and ratings, Identification of areas of non-compliance and potential safety hazards from audit results.

Unit V	Safety Equipment and Personal Protective Equipment (PPE)	(04 hrs.)	COs Mapped - CO5

Safety equipment : role in preventing workplace injuries and illnesses, Types of Personal Protective Equipment (PPE) : helmets, gloves, safety glasses, high-visibility clothing, safety footwear, and respiratory protective equipment. Proper use and maintenance of PPE : Guidelines for the maintenance, storage, and replacement of PPE.

Text Books

1. Akhil Kumar Das, Principles of Industrial Safety Management: Understanding the Ws of Safety at Work (2010) , PHI Learning
3. A.K. Gupta, Industrial Safety and Environment (2012) , Laxmi Publications
4. S.C. Sharma, Industrial Safety, (4th Edition), Khanna Book Publishing.
5. Prof. Sunil S. Rao and R.K. Jain (2010), Industrial Safety, Health and Environment Management Systems, Khanna Publishers.

Strength of CO-PO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	-	-	-	-	-	3	-	3	-	-	3	-	-	-
CO2	-	-	-	-	-	3	-	3	-	3	3	-	-	-
CO3	-	-	3	-	-	3	-	3	-	3	-	-	-	-
CO4	-	3	-	3	-	3	-	3	-	3	-	-	-	-
CO5	-	-	-	3	-	3	-	3	-	3	3	-	-	-
Average	-	3	3	3	-	3	-	3	-	3	3	-	-	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on Unit-1 to Unit-4.	30
2	LMS Tests	20
	Total	**50**

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223008: Air Pollution and Control

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs./week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks**

Prerequisite Courses: - Basic concepts of sciences, mathematics

Course objectives :
1. Make aware about the meteorology, measurement techniques, emission inventory and modeling aspects.
2. Impart the knowledge and understanding of outdoor and indoor air pollution, its impact and existing legislation and regulation.
3. Provide the scientific and technical background of state of the art air pollution control technologies

Course Outcomes: The course will enable the students to–

	Course Outcomes	**Bloom's Level**
CO1	Estimate air pollution concentration at receptor level on the basis of meteorological conditions.	2-Estimate
CO2	Analyse Ambient air & stack gas quality for preserving environmental conditions.	4. Analyse
CO3	Discuss about the control of Indoor air quality and odour pollution.	2- Discuss
CO4	Describe various principles of control equipment's of air pollution.	2- Describe
CO5	Identify , predict and assess the environmental impact due to setting up of engineering project	1-Identify 3-predict

COURSE CONTENTS

Unit I	**Meteorological aspects**	**(08 hrs.)**	**COs Mapped – CO1**

Zones of atmosphere, Scales of meteorology, Meteorological parameters, Temperature lapse rate, Plume behaviour. Gaussian diffusion model for finding ground level concentration, Plume rise, Types & quality of fuels, Formulae for effective stack height and determination of minimum stack height as per CPCB norms.

Unit II	**Ambient Air sampling and analysis**	**(07 hrs.)**	**COs Mapped – CO2**

Air pollution survey, basis and statistical considerations of sampling sites, devices and methods used for sampling of gases and particulates. Stack emission monitoring for particulate and gaseous matter, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Emission inventory and source apportionment studies. Ambient air quality monitoring as per the procedure laid down by CPCB. National Ambient Air Quality Standards (NAAQS) 2009

Unit III	**Indoor air pollution**	**(07 hrs.)**	**COs Mapped – CO3**

Causes of air pollution, sources and effects of indoor air pollutants, factors affecting exposure to indoor air pollution, sick building syndrome. Investigation of indoor air quality problems, changes in indoor air quality, control of indoor air pollutants and air cleaning systems. Use of various plants to control indoor air pollution. Radon and its decay products in indoor air. Odour pollution: Theory, sources, measurement

and methods of control of odour pollution			
Unit IV	**Control of air pollution:**	**(07 hrs.)**	**COs Mapped – CO4**
By process modification, change of raw materials, fuels, process equipment and process operation. Control of particulate matters. Working principle and design of control equipment as Settling chamber, Cyclone, Fabric filter and Electro Static Precipitator. Control of gaseous pollutants. & control of air pollution from automobiles.			
Unit V	**Legislation and Environmental Impact Assessment (EIA)**	**(07 hrs)**	**COs Mapped – CO5**
The environmental rules 1999 (sitting of industries). Land use planning: As a method of control. Economics of air pollution control: Cost/benefit ratio and optimization. Legislation and regulation: Air (Prevention and Control) Pollution Act, 1981. The Environment (Protection) Act 1986. Emission standards for stationary and mobile sources. Methodology for preparing environmental impact assessment (Identifying the sources of air pollution, calculating the incremental values, prediction of impacts and mitigation measures). Role of regulatory agencies and control boards in obtaining environmental clearance for project. Public hearing. Environmental impacts of thermal power plants, sugar and cement industry. Environmental management plan.			

Text Books

1. Air Pollution – H. V. N. Rao and M. N. Rao, TMH, Pub.
2. Air pollution – KVSG Murali krishna.

Reference Books

1. Air Pollution – Perkins.
2. Environmental Engineering – Davis, McGraw Hill- Pub.
3. Environmental Engineering – Peavy H.S and Rowe D.R, McGraw Hill- Pub.
4. Air Pollution – Stern.
5. Air Pollution Control – Martin Crawford.
6. Air Pollution Control: its origin and control, K. Wark, C.F. Warner & W.T.Davis .
7. Fundamentals of Air Pollution-Richard W. and Donald L. Academic Press.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	1	3	2	1	1	2	1	1	1	-
CO2	3	1	-	1	1	3	2	-	3	1	1	1	-	-
CO3	2	-	-	-	-	3	1	-	-	1	-	1	-	-
CO4	3	-	1	-	-	1	1	-	-	1	-	1	-	-
CO5	-	-	-	-	-	3	2	2	-	3	-	1	-	-
Average	**2.75**	**1.0**	**1.5**	**1.0**	**1.0**	**2.60**	**1.60**	**1.5**	**2.0**	**1.60**	**1**	**1**	**1**	**-**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Test	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: V (B. Tech Civil Engineering)
CIV223010: Seminar

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Tutorial: 01 hr/week **Practical :02 hrs/week**	**01** **01**	**Tern work: 50 Marks**

Prerequisite Courses, if any: -

Course Objectives:

1. To create student's interest in learning through various project ideas in civil engineering.
2. To develop creativity, research attitude, skills required project work.
3. To incorporate the technical knowledge in solving of real life problems in civil engineering.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	To identify the social needs and real life problems in civil engineering	2-Understanding
CO2	To generate ideas and decide the most optimized alternative in practice.	3-Applying
CO3	To utilize various tools to solve the identified problem.	4-Analysing

COURSE CONTENTS

Introduction to seminar work? Applications and research trends case studies in Civil Engineering. Introduction to design thinking, ideation. Introduction of various thrust areas in Civil Engineering. Sample case studies in Civil Engineering. Introduction of patents, copyright, publications etc.	**COs mapped CO1, CO2, CO3**

Guidelines for Conduction

Subject faculty will conduct the sessions on course content of seminar. Faculty will form small groups of students. Each group has to select one problem in field of civil engineering and decide the topic of seminar. Topics will be based on study, identification of problems and improvement in existing systems in Civil Engineering, generation of new ideas for development of engineering systems to solve field problems. A mentor/guide will be assigned to each group. Students will work on the topic using various analytical/mathematical/ICT tools, case studies etc. and will submit a report at the end of semester.

Guidelines for Student's Seminar Report

Sequence of pages:
i) Front Cover Page ii) Certificate iii) Acknowledgement iv) Abstract v) Contents vi) List of Figures vii) List of Tables vii) Abbreviations
Chapter 1 Introduction (Introduction , Problem Statement, Objectives , Scope of the Project Works, Expected outcomes)
Chapter 2 Literature Review (It shall include theoretical support, details regarding work done by Earlier research, methods established any new approach)
Chapter 3 Planning Schedule/ Flow Chart for Completion of Project
Chapter 4 Conclusion
References and Bibliography
Report Printing details:
1. Report shall be typed on A4 size Executive Bond paper with single spacing preferably on **Both** sides of paper.

2. Margins: Left Margin: 37.5 mm, Right Margin: 25 mm, Top Margin: 25 mm, Bottom Margin: 25 mm.
3. Give page number at bottom margin at center.
4. Size of Letters: Chapter Number: 16 font size, Times New Roman in Capital Bold Letters, Chapter Name: 12 Font size in Capital Bold Letters, Main Titles (1.1, 2.5 etc): 16 Font size in Bold Letters Sentence case, Sub Titles (1.1.5, 4.5.1 etc): 14 Font size in Bold Letters Sentence case. All other matter: 12 Font size sentence case.
5. No blank sheet be left in the report.
6. Figure name: 12 Font size in sentence case Bold- Below the figure.
7. Table title -12 font size in sentence case- Bold-Above the table.

Guidelines for Termwork Assessment

A continuous assessment will be done by Subject Faculty/Mentor/Guide. Assessment will be based on Problem Identified, Idea generated, Methodology to implement the project, Involvement in a group, presentation,/demonstration and PBL report.

Reference Books

M. Savin-Baden and C. Howell Major, Foundations of Problem-based Learning. McGraw-Hill Education, 2004

Website for references

1. www.swayam.gov.in/nd2_ntr20_ed12/preview

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	2	2	2	2	3	3	2	3	3	2
CO2	3	3	3	2	2	2	2	2	3	3	2	3	3	2
CO3	3	3	3	2	2	2	2	2	3	3	2	3	3	2
Average	3	3	3	2	2	2	2	2	3	3	2	3	3	2

SEMESTER VI

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223011: Dams and Hydraulic Structures

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week **Practical(CIV223013):** **02 hrs/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks** **Term Work(CIV223013): 25 Marks** **Oral Exam(CIV223013) : 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mathematic and Knowledge of Hydrology and Water Resources Engineering.

Course Objectives:

1. To study different types of dams and instrumentation
2. To study the stability analysis of Gravity Dam
3. To study the spillways and design philosophy of Ogee spillway.
4. To study the failures and stability analysis of an earthen dam
5. To study design of canals and types of canal structures
6. Analysis of design of diversion headwork and of Cross drainage work

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand types of dams and instrumentation working	2-Understand
CO2	Execute stability analysis of Gravity Dam	3-. Apply 4-Analyze
CO3	Understand the spillways & Design of Ogee spillway	2-Understand 3. Apply
CO4	Understand the earthen dam and analyze stability of earthen dam.	2-Understand 3-Apply
CO5	Design Canals and Analysis of the Diversion headwork and Cross Drainage work	3-Apply 4-Analyze

COURSE CONTENTS

Unit I	**Introduction to Dam**	**(08 hrs.)**	**COs Mapped - CO1, CO2.**

Introduction, historical development of dams, different terms related to dams, selection of site of dam, factors governing selection of type of dam, classifications of dam, classification based on purpose, material, size of project, hydraulic action, structural action.
Introduction to Colgrout masonry dam, Roller Compacted Concrete (R.C.C) dam, Ferrocement dam
Introduction of arch dam and buttress dam including classification, advantages and limitations.
Dam Safety and Instrumentation: Significance of Instrumentation: introduction, objectives of dam safety and instrumentation. Working principles and functions of different instruments such as piezometer, porous tube piezometer, pneumatic piezometer, vibrating wire piezometer, vibrating wire settlement cell, inclinometer, joint meter, pendulums, inverted pendulum, hanging pendulum, automatic pendulum coordinator, vibrating wire pressure cell, extensometer, embedment strain gauge, temperature gauge, distributed fiber optics temperature tool, seismograph..

Unit II	**Gravity Dam**	**(07 hrs.)**	**COs Mapped - CO1, CO2**

Introduction, components of gravity dam, conditions favoring gravity dam, forces acting on gravity dam, combination of loading for design, seismic analysis of dam, determination of seismic forces (Zangger's method), effect of horizontal earthquake acceleration, effect of vertical earthquake acceleration, middle third rule, modes of failure of gravity dam, elementary profile of gravity dam, various design methods of gravity dam (introduction only), details of gravity method or 2 D method,
Construction of gravity dam, temperature
controlling in mass concreting, crack formation in gravity dam, control of crack formation in dam, Construction joints, keys, water seal.

Unit III	Spillway	(07 hrs)	COs Mapped –CO3

Introduction different key levels and heads in spillway, components of spillway, classification of spillway, classification based on operation, gates, special features.
Design of ogee spillway, shape of crest, equations for spillway profile on upstream and downstream,
Energy dissipation below spillway, classification of energy dissipation devices, components of stilling basin, types of stilling basins, Correlation between jump height and tail water depth,
Spillway gates: Different Types, Maintenance of gates.

Unit IV	Earthen Dam	(07 hrs)	COs Mapped - CO4

Introduction, conditions favoring on earth dam, limitations of earth dam, classification of earth dam, selection of type of earth dam, components of earth dam, requirements for safe design of earth dam, forces acting on earth dam
Hydraulic (seepage) analysis, plotting of phreatic (seepage) line, stability analysis of zoned earth dam by Swedish slip circle method, fellenius method of locating center of critical slip circle, failure of earth dam, classification of failure of earth dams
Seepage control in earth dams causes of seepage, seepage control measures,
Construction of earth dam.

Unit V	Canals and Diversion head works	(07 hrs)	COs Mapped - CO1, CO5.

Introduction, classification of canals, classification based on alignment, soil, source of supply, discharge, lining, Components of canal, data required for canal design, selection of canal alignment,
Design of canal by Lacey's theory, design of lined canal, canal lining, necessity of canal lining, requirement of lining material and types of lining.
Canal Structures: Canal falls, canal outlets, canal escapes, canal regulators, cross and head regulator.
Introduction, function of diversion head works, selection of sites for diversion head works, components of diversion head works, brief introduction to Bligh and Lane's theory, Khosla's theory of independent variables, design of weirs on permeable foundations by Khosala's theory.
C. D. Works: Introduction, Necessity of Cross Drainage works, Selection of site for Cross Drainage work, Selection of suitable type of C. D. works, Classification of cross drainage works, Functioning of syphon, super passage, aqueduct, syphon aqueduct, level crossing.

Text Books

1. Irrigation Engineering and Hydraulic Structures, Garg S. K, Khanna Publication.
2. Irrigation, Water Resources and Water Power Engineering, Modi P. N., Standard Book House, New Delhi.

Reference Books

1. Irrigation Water Power Engineering, Punmia B. C., Laxmi Publication.
2. Design of Small Dams, United States Department of the Interior, Bureau of Reclamation revised reprint 1974, Oxford and IBH Publishing Co.

Indian Standards

1. IS 8605: 1977 (Reaffirmed 1998), Code of practice for construction of masonry in dams, Third reprint, July 1999, Bureau of Indian Standards, New Delhi.
2. IS 6512: 1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, First reprint, September, 1998, Bureau of Indian Standards, New Delhi.
3. IS 457: 1957 (Reaffirmed 2005), Code of practice for general construction of plain and Reinforcement concrete for dam and other massive structures, sixth reprint, January 1987, Bureau of Indian Standards, New Delhi.
4. IS 1013: 1985, Code of practice for drainage system for gravity dams, their foundations and abutments, first revision, Bureau of Indian Standards, New Delhi.
5. IS 14591: 1999, Temperature control mass concrete for dams - guidelines, Bureau of Indian Standards, New Delhi.
6. IS 11223: 1985, (Reaffirmed 2004), Guidelines for fixing Spillway capacity, edition 1.2 (1991-09), Bureau of Indian Standards, New Delhi.
7. 07 IS 6934: 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillwaysRecommendation, First revision, Bureau of Indian Standards, New Delhi.
8. IS 11155: 1994, Construction of spillways and similar overflow structures- Code of practice, Bureau of Indian Standards, New Delhi.
9. IS 5186: 1994, Design of Chute and side channel spillway-criteria, first revision, Bureau of Indian Standards, New Delhi.
10. IS 5186: 1994, Design of Chute and side channel spillway-criteria, first revision, Bureau of Indian Standards, New Delhi.
11. IS 10317: 1982 (Reaffirmed 2004), Guidelines for selection of spillways and energy dissipaters, Bureau of Indian Standards, New Delhi.
12. IS 4997: 1968 (Reaffirmed 1995), Criteria for design of hydraulic jump type stilling basins with horizontal and sloping apron, sixth reprint, January, Bureau of Indian Standards, New Delhi.
13. IS 7365: 1985, Criteria for hydraulic design of bucket type energy dissipaters, first revision, Bureau of Indian Standards, New Delhi.

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	3	1	1	1	1	1	-	1	2	3	3
CO2	2	2	2	-	-	-	2	2	2	2	2	2	2	2
CO3	3	2	2	2	1	1	1	2	2	2	2	2	2	2
CO4	3	1	1	2	-	2	2	3	2	2	3	3	3	1
CO5	3	2	2	2	1	1	1	2	2	2	2	2	2	2
Average	2.8	2	2	1.8	1	1.25	1.4	2	1.8	2	2	2.2	2.4	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests on each unit	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223012: Foundation Engineering

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks**

Prerequisite Courses, if any: - The basic knowledge of Geotechnical Engineering.

Course Objectives:

1. To know various methods for subsurface investigations for foundations.
2. To learn to perform geotechnical design of shallow and deep foundations.
3. To study the problems related to foundations on expansive soil and ways to solve them.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Perform subsurface investigations for foundations using different methods.	1.Remember
CO2	Understand the steps in geotechnical design of shallow foundations and well foundations.	2. Understand
CO3	Calculate immediate and primary consolidation settlement of shallow foundations.	3. Apply
CO4	Estimate the bearing capacity of shallow foundations	4. Analyze
CO5	Decide the capacity of a pile and pile group.	5.Evaluate

COURSE CONTENTS

Unit I	**Subsurface Investigations for Foundations**	**(08 hrs.)**	**COs Mapped - CO1**

Purpose and planning of subsurface exploration, methods of Investigation: trial pits, borings, depth & number of exploration holes, core recovery, RQD, core log, geophysical methods: seismic refraction and electrical resistivity method, disturbed and undisturbed sampling, types of samplers, degree of disturbance of a sampler, field tests- SPT, N value correction and significance, DCPT, SCPT and introduction of advanced testing techniques like pressure meter test, borelog, contents of sample soil investigation report.

Unit II	**Bearing Capacity**	**(07 hrs.)**	**COs Mapped - CO2**

Basic definitions, modes of shear failure, bearing capacity analysis- Terzaghi's, Hanson's, Meyerhof's, Skempton's, Vesics equations and IS code method - rectangular and circular footings, bearing capacity evaluation: plate load test and SPT, Housel's perimeter shear concept, bearing capacity of layered soil, effect of water table on bearing capacity, effect of eccentricity, presumptive bearing capacity

Unit III	**Immediate and Consolidation Settlement**	**(07 hrs)**	**COs Mapped –CO3**

Immediate Settlement: introduction, causes of settlement, pressure bulb, contact pressure, significant depth of foundation, allowable settlement, differential settlement - I. S. criteria, components of settlement, use of plate load test and SPT in settlement analysis and allowable soil pressure.

Consolidation Settlement: introduction, spring analogy, Terzaghi's consolidation theory, laboratory consolidation test, determination of coefficient of consolidation- square root of time fitting method and logarithm of time fitting method, time factor, rate of settlement and its applications in shallow foundations, introduction of normal consolidation, over consolidation and pre consolidation pressure.

Unit IV	Pile Foundations	(07 hrs)	COs Mapped - CO4

Introduction: pile classification according to different criteria, pile installation - Cast in-situ, driven and bored pile, load carrying capacity of pile by static method, dynamic Methods: Engineering news formula, modified ENR formula and modified Hiley formula, pile load test and cyclic pile load test, group action: field rule, rigid block method, negative skin friction, settlement of pile group in cohesive soil by approximate method, uplift capacity of piles, micro piles.

Unit V	Shallow foundations, Piers and Caissons	(07 hrs)	COs Mapped - CO5

Shallow Foundations: types and applications, location and depth of footing, principles of design of footing, steps involved in proportioning of footing, proportioning of combined footings – rectangular, trapezoidal and strap footing, raft foundation- types, bearing capacity, floating raft, design of raft foundation- conventional (rigid) method and elastic (flexible) method (only design principles and steps, no numerical).

Piers and Caissons: definitions, types and uses, well foundation: components, sand island method, shapes of wells, tilts and shifts: precautionary and remedial measures, bearing capacity and depth of well foundation, forces acting on well foundations, lateral stability of well foundation – Terzaghi's method, IRC method, ultimate soil resistance method (only numerical on lateral stability analysis, no derivation for methods).

Text Books

1. Foundation Engineering by P. C. Varghese, PHI Learning Pvt. Ltd.
2. Soil Mechanics and Foundation Engineering by A. K. Arora, Standard Publishers.
3. Soil Mechanics and Foundation Engineering by V. N. S Murthy, Marcel Dekker, Inc. New york.
4. Soil Mechanics and Foundation Engineering by B. C. Punmia, Laxmi Publicationselhi.

Reference Books

1 Basic and Applied Soil Mechanics by Gopal Ranjan and A. S. Rao, New Age International Publishers.
2 Principles of Foundation Engineering, Braja M. Das, PWS Publishing Company.
3 Geotechnical Engineering by Shashi K. Gulati & Manoj Datta, Tata McGraw Hill.
4 Foundation Analysis and Design, J. E. Bowels, McGraw-Hill.

Strength of CO-PO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	3	2	1	1	1	-	2	2	3	2	2
CO2	3	2	2	2	2	1	2	1	-	1	2	3	3	2
CO3	3	2	2	-	2	1	2	1	-	-	1	3	3	2
CO4	3	2	2	-	2	1	2	1	-	-	2	3	3	2
CO5	3	2	2	-	2	1	3	1	-	1	2	3	3	2
Average	3	2	1.8	2.5	2	1	2.4	1	-	1.33	1.8	3	2.8	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering):
CIV223013: Dams and Hydraulic Structures Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term work: 25 Marks.** **Oral Exam : 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mathematic and Knowledge of Hydrology and Water Resources Engineering.

Course Objectives:

7. To familiarize students with different types of dams their functions, components, and basic design principles.
8. To equip students with the knowledge and skills necessary for the design, analysis, and evaluation of dams and hydraulic structures considering various factors.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand types of dams and instrumentation working	2-Understand
CO2	Execute stability analysis of Gravity Dam/Earthen Dam.	3-. Apply 4-Analyze
CO3	Understand the spillways & Design of Ogee spillway	2-Understand 3. Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Stability analysis of gravity dam by 2d method	**CO1**
2	Design of profile of spillway	**CO3**
3	Design of energy dissipation device below the spillway	**CO3**
4	Stability analysis of zoned earthen dam (Preferably use of Auto CAD sheet)	**CO2**
5	Design of lined canal	**CO1**
6	Min.5 Site visits and reports with photographs of the following ... Gravity dam / Earthen dam / Spillway / CD work /Canal structures / Barrage	**CO1,CO2,CO3**

Guidelines for Laboratory Conduction
6. Teacher will brief the given experiment to students its procedure, tools, and outcome of the practical. 7. Computers and software required for the allotted experiment will be provided by the lab assistants using SOP. 8. Students will perform the allotted practical individually under the supervision of faculty and lab assistant. 9. After checking they have to write the outcome of the practical.
Guidelines for Student's Lab Journal
Write-up should include title, aim, numerical and code.
Guidelines for Termwork Assessment
3. Each experiment from lab journal is assessed for thirty marks based on three rubrics. 4. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223014 A: Advanced Geotechnical Engineering

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks**

Prerequisite Courses, if any: - The basic knowledge of Geotechnical Engineering.

Course Objectives:

1. To learn the classification of soil, soil structure, role of water in clay, earth pressure on retaining structures and the design of retaining structures.
2. To study types of triaxial tests and draw the stress paths.
3. To know methods to implement soil stabilization and different ground improvement techniques

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Classify the soil and understand the soil structure and role of water in clay.	2.Understand
CO2	Interpret the results of triaxial tests under different drainage conditions.	2. Understand
CO3	Select and implement soil stabilization techniques based on field conditions.	2. Understand
CO4	Explain different ground improvement techniques.	2. Understand
CO5	Calculate lateral pressure on retaining structures and carry out design the retaining structures.	3.Apply

COURSE CONTENTS

Unit I	**Soil Classification, Soil Structure and Clay Minerals**	**(08 hrs.)**	**COs Mapped - CO1**

Soil identification and classification, criteria for classifying soil, classification on the basis of grain size, plasticity, symbolic and graphic presentation, classified soils and engineering properties, USCS, BIS, AASHTO and textural classification systems. Clay minerals, clay water relations, clay particle interaction, soil structure & fabric, granular soil fabric.

Unit II	**Earth Pressure Theory and Design of Earth Retaining Structures**	**(07 hrs.)**	**COs Mapped - CO5**

Types of earth retaining structures, design of gravity and cantilever retaining walls, bracing system and apparent earth pressure diagram for open cuts, only concept of cantilever sheet pile walls and an anchored sheet pile walls, Reinforced earth retaining wall: general principles, concepts and mechanism of reinforced earth , design consideration of reinforced earth: geotextile, geogrids, metal strips and facing elements, construction: selection of type of retaining structures, construction practice, field observations.

Unit III	**Shear Strength of Soil**	**(07 hrs)**	**COs Mapped –CO2**

Shear strength of clay soils: undrained strength from UU test, consolidated undrained strength from CU test, consolidated drained strength from CD test, stress strain and volume change relationship. Shear strength of sands: stress strain and volume change relationship, behavior of saturated sand under drained

and undrained conditions, factors affecting angle of shearing resistance, pore pressure parameters and determination.			
Unit IV	**Soil Stabilization**	**(07 hrs)**	**COs Mapped - CO3**
Soil stabilization: introduction, objectives, factors affecting stabilization of soils, methods of stabilization: mechanical, cement, lime, bituminous; classification of stabilizing agents and stabilization processes. Lime stabilization: base exchange mechanism, pozzolanic reaction, lime-soil interaction, cement stabilization: mechanism, amount, fly-ash: lime stabilization and soil bitumen stabilization.			
Unit V	**Ground Improvement**	**(07 hrs)**	**COs Mapped - CO4**
In-situ ground improvement by compaction piles, dynamic loads, explosion sand drains, grouting, deep mixing, inserting reinforcement elements, freezing soil, and vibroflotation without numerical.			

Text Books

1 Basic and Applied Soil Mechanics, Gopal Ranjan and A. S. Rao, New Age Publication.
2 Geotechnical Engineering, Shashi K. Gulati and Manoj Datta, Tata Mc-Grawhill.
3 Soil Mechanics and Foundation Engineering, Dr. B. C. Punmia, Laxmi Publications

Reference Books

1 Principles of Geotechnical Engineering, Braj M. Das, Cengage Learning.
2 Advance Soil Mechanics, Braja Mohan Das, Tata Mc- Graw Hill
3 Physical and Geotechnical properties of soils, Joseph E. Bowels, Tata Mac-Graw Hill.
4 Foundation Analysis and Design, Joseph E. Bowels, Tata Mc-Graw Hill.
5 Ground Improvement Techniques, P. Purushothama Raj, Laksmi Publications, New Delhi.

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	2	--	--	--	2	--	--	--	3	3	--	--	2	--
CO2	1	2	1	3	3	--	--	--	3	--	1	1	1	2
CO3	2	--	1	--	3	--	--	--	2	--	1	1	2	--
CO4	2	2	--	--	3	--	--	--	2	--	1	1	2	2
CO5	2	--	2	--	2	--	1	1	2	2	3	1	2	--
Average	1.8	2	1.33	3	2.6	-	1	1	2.4	2.5	1.5	1	1.8	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223014 B : Design of Steel Structures

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mechanics, Mechanics of Structures, Structural Analysis

Course Objectives:

1. To provide the students with basic concepts of steel structures.
2. To analyze and design different component of steel structures.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Identify modes of failure, the nature of different components of steel structures and apply suitable IS provisions	Apply
CO2	Analyze roof truss subjected to different load combinations	Analyze
CO3	Design axially/ eccentrically loaded column with suitable type of column base	Evaluate
CO4	Design tension and compression member along with their connections	Evaluate
CO5	Design beam & girder along with suitable stiffeners and their connections	Evaluate

COURSE CONTENTS

Unit I	**Design Philosophy and Tension Members**	**(08 hrs.)**	**COs Mapped - CO1, CO2.**

Types of steel structures, the chemical composition of structural steel, grades of structural steel, various rolled steel sections, relevant IS specifications such as IS:800-2007, IS:808-1989, IS:875 part I to III, SP: 6(1), SP: 6(6), SP:38, IS: 4000-1992, IS 816–1969, maintenance of steel structure and its methods. Philosophy of limit state design for strength and serviceability, the partial safety factor for load and resistance, various design load combinations. Tension member: various cross sections such as solid threaded rod, cable and angle sections limit strength due to yielding, rupture and block shear, design of tension member using single and double angle sections and design of connection.

Unit II	**Design of Compression Members and Columns**	**(07 hrs.)**	**COs Mapped - CO1,**

Buckling classification, buckling curves, classification of cross, effective length for compression members and columns, design compressive stress, design of compression member of trusses using single and double angle section and design of connections. Design of axially loaded column using rolled steel section, design of built-up column, lacing and battening and its connections.

Unit III	**Eccentric Loaded Columns and Column Bases**	**(07 hrs.)**	**COs Mapped -CO1,**

Design of eccentrically loaded column providing uniaxial and biaxial bending for section strength, Design of column bases: slab base, gusseted base and moment resistant base f o r axial load and uni-axial bending

Unit IV	**Design of Flexural Members**	**(07 hrs)**	**COs Mapped -**

Design bending strength, laterally restrained and unrestrained beams, design of laterally restrained beams using single rolled steel section with and without flange plate, curtailment of flange plates, low and high shear, check for web buckling, web crippling and deflection. Design of laterally unrestrained beams using single rolled steel section, check for and deflection

Unit V	**Design of Industrial truss and Girder**	**(07 hrs)**	**COs Mapped -**

Roof truss: assessment of dead load, live load and wind load, design of purlin, design of members of a truss, detailing of typical joints and supports.
Introduction to girder: plate & gantry girder, their components, loads acting
Concept of plate girder, components of welded plate girder, intermittent weld, design of cross section, curtailment of flange plates, end bearing, load bearing, and intermediate stiffeners, design of connection between flange & web plate and web plate & stiffeners, check for shear buckling of web, shear capacity of end panel and serviceability condition.

Text Books

6. Limit State Design of Steel Structures, S K Duggal, Tata McGraw Hill Education, New Delhi
7. Design of Steel Structure by Limit State Method as per IS: 800- 2007, Bhavikatti S S, I. K. International publishing house, New Delhi
8. Design of Steel Structures, K. S. Sai Ram, Pearson, New Delhi

Reference Books

5. Design of Steel Structure, N Subramanian, Oxford University Press, New Delhi
6. Limit State Design in Structural Steel, M. R. Shiyekar, PHI, Delhi
7. Fundamentals of structural steel design, M L Gambhir, Tata McGraw Hill Education Private limited, New Delhi.

Strength of CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1	1	2	-	1	1	1	-	1	2	1
CO2	2	2	2	1	1	2	-	1	1	1	-	1	2	1
CO3	3	3	3	2	2	2	-	2	2	2	-	2	3	2
CO4	3	3	3	2	2	2	-	2	2	2	-	2	3	2
CO5	3	3	3	2	3	2	-	2	2	2	-	2	3	2
Average	**2.7**	**2.8**	**2.7**	**1.7**	**2.0**	**2.0**	**-**	**1.7**	**1.7**	**1.7**	**-**	**1.7**	**2.7**	**1.7**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments (Analysis of truss using suitable software, one full imperial sheet for truss, design of tension, compression members of truss, design of column, column base, Design of beam/ plate girder using spreadsheet/ programming language, plates carrying suitable design sketches)	15
2	LMS tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering):
CIV223014 C:Coastal Engineering

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks**

Prerequisite Courses, if any: -.Fluid Mechanics, Mathematics and Statistics

Course Objectives:

1. To make students aware of the basics of ocean waves.
2. To introduce students to the properties and analysis of waves.
3. To impart knowledge about tides and their dynamic theory.
4. To introduce students to important aspects of longshore transport.
5. To impart knowledge about coastal structures and shore protection.
6. To impart knowledge about coastal management.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand the concepts of small amplitude wave theory, Linear (Airy) wave theory, and the introduction to non-linear waves.	1-Remember
CO2	Remember the concepts of waves in shallow waters, unusual character waves, and the methods of hind casting and forecasting of waves.	1-Remember
CO3	Comprehend the dynamic theory of tides, types of tides, and the concept of tidal power.	2-Understand
CO4	Evaluate the stability of inlets and the effect of construction of coastal structures on the stability of shoreline/beaches.	3-Apply
CO5	Analyze the types of coastal structures, the concept of risk analysis, and design waves.	4-Analyze

COURSE CONTENTS

Unit I	**Basics of Ocean waves**	**(08 hrs.)**	**COs Mapped - CO1, CO2.**
Introduction to wind and waves, Sea and Swell, classification of ocean waves, wave measurement, introduction to small amplitude wave theory, Linear (Airy) wave theory, use of wave tables.			
Unit II	Wave Mechanics and Analysis	**(07 hrs.)**	**COs Mapped - CO1, CO2.**
Wave propagation, refraction, diffraction, breaking and shoaling, waves in shallow waters, hindcasting and forecasting of waves, short term wave analysis, wave spectra and its utilities.			
Unit III	**Tides and Coastal Dynamics**	**(07 hrs)**	**COs Mapped –CO3**
Definition and basic characteristics of tide, process of generation of tide, tide producing forces: earth moon and earth sun system, dynamic theory of tides, types of tides, coastal process: erosion/accretion due to waves, bed forms			
Unit IV	**Coastal Processes and Sediment Transport**	**(07 hrs)**	**COs Mapped - CO4**

Long shore transport (Littoral drift), estimate of wave induced sediment, budget, tides, effect of tides, stability of inlets, coastal sedimentation.			
Unit V	**Coastal Engineering and Management**	**(07 hrs)**	**COs Mapped - CO5.**
Introduction to coastal structures and their types, concept of risk analysis and design waves, introduction and necessity of shore protection, methods of shore protection, coastal zone management, and issues related to integrated coastal zone management, coastal regulation zone.			

Text Books

1. Coastal Hydrodynamics, J.S.Mani, PHI India Publications
2. Ocean wave Mechanics-Applications in Marine Structure, V.Sundar, Ane Books Pvt Ltd
3. Harbour and Coastal engineering Vol I & II, Ocean and Coastal Engineering Publication

Reference Books

1. 01 Port planning, Qeen A. D. Mc Grow Hill Book Co. New York.
2. 02 Coastal engineering, Vol-I-II, Silvester Richard, University of Western Australia.
3. 03 Shore Protection Manual, U. S. Waterways Experiment Station Corps of Engineer.
4. 04 Costal Engineering Research Center, Vickburg and USA1984,Coastal Protection Manual 2002.

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	-	-	3	-	2	-	-	-	-	3	-	-
CO2	3	3	-	-	3	-	2	-	-	-	-	3	-	-
CO3	3	3	-	2	3	-	2	-	-	-	-	3	3	2
CO4	3	3	3	-	3	3	2	-	-	2	-	3	2	-
CO5	3	3	-	2	3		2	-	-	-	-	3	2	3
Average	3	3	3	2	3	3	2	-	-	2	-	3	2.3	2.5

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223014 D: Advanced Mechanics of Structures

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **InSemExam:20Marks** **End SemExam:60Marks**

Prerequisite Courses, if any:-Fundamental of Engineering Mechanics and Mechanics of Structures

Course Objectives:

1. To learn the concept of moment area and conjugate beam method to find slope and deflection
2. To study different type of stresses in thin and thick cylindrical shells
3. To learn application of influence line diagram to find the forces in the members due to moving load
4. To study the analysis of beams and arches

Course Outcomes: Oncompletion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Apply moment area and conjugate method to find slope and deflection	3-Apply
CO2	Evaluate stresses and strain in thin and thick cylinder	3-Apply
CO3	Analyze the beam and trusses by influence line diagram.	4-Analyze
CO4	Understand and analyze beam curved in plan and elevation.	4-Analyze
CO5	Analyze three and two hinged arches for axial thrust, shear and moment..	4-Analyze

COURSECONTENTS

UnitI	**Slope-Deflection by Moment Area and Conjugate Beam Methods**	**(08hrs.)**	**COs Mapped-CO1**

Moment area method: basic concept, M/EI diagram, slope and deflection of cantilever subjected to moment, point load and uniformly distributed load.
Conjugate beam method: basic concept, slope and deflection of beams subjected to moment, point load and uniformly distributed load.

UnitII	**Thin and Thick Cylinders**	**(07 hrs.)**	**COs Mapped-CO2**

Thin cylinders: basic concept, circumferential, longitudinal and shear stresses, circumferential, longitudinal and volumetric strain, effect of compressible and non-compressible fluid injected under pressure.
Thick cylinders: basic concept, thick cylinder subjected to internal and external pressure, derivation of Lame's equation for radial and circumferential stresses, representation of radial and circumferential stresses..

Unit III	**Influence Line Diagrams**	**(07 hrs)**	**COs Mapped –CO3**

A)Influence line diagram for beams: introduction, influence line diagram for reaction, shear and moment for simple beam, influence line diagram for girder and compound beam and application of influence line diagram. Influence line diagram for trusses: bridge floor system, influence line diagram for truss reaction, member forces, determination of maximum forces and influence line diagram for non parallel chord

members.
B) Introduction, maximum shear force and bending moment at any section of beam subjected to uniformly distributed and two point load. Maximum end shear force, shear force at section, bending moment at section and absolute maximum moment, equivalent uniformly distributed load.

Unit IV	**Beams Curved in Plan and Elevation**	**(07 hrs)**	**COs Mapped-CO4**

Beams curved in plan: Introduction, circular beam loaded with uniformly and supported on symmetrically placed column, simply supported semicircular beam supported on three supported equally spaced, quarter circle beam fixed at one end and free at other end carrying point load at free end. Beams curved in elevation: Introduction, assumptions, expression for flexural stresses in curve beam/ Winkler-Bach theory, different cross section for curved beam.

Unit V	**Three and Two Hinged Arches**	**(07 hrs)**	**COs Mapped-CO5.**

Three hinged arches: basic concept, linear arch, bending moment: Eddy's theorem, analysis of three hinged circular and parabolic arch subjected to uniformly distributed, Influence line diagram for axial thrust, shear and moment of three hinge arches. Two hinged arches: basic concept, analysis of two hinged circular and parabolic arch subjected to uniformly distributed and point loads respectively considering supports at same level.

TextBooks

1. Analysis of Structure, Vol II, V N Vazirani, M MRatwani and S K Duggal, Sixteenth Edition, Khanna Publisher, Delhi
2. Mechanics of Structures, Vol. I & II, S B Junnarkar and H J Shah, Twenty FourthEditions, Charotar Publishing House, Pvt Ltd, Anand

ReferenceBooks

1. Strength of Materials, Stephen Timoshenko, Third Edition, CBS Publisher &distributer,New Delhi
2. Theory of Structures Vol I, G S Pandit, S P Gupta and R Gupta, McGraw Hill Education(India) Pvt Ltd, New Delhi
3. Structural Analysis in SI Units, R C Hibbler, Pearson Education
4. Mechanics of Materials, E P Popov, Pearson

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	3	3	3	-	-	-	-	-	3	3	-
CO2	3	3	3	3	3	3	-	-	-	-	-	2	3	-
CO3	3	3	2	3	2	3	-	-	-	-	-	2	3	-
CO4	3	3	3	3	3	3	-	-	-	-	-	3	3	-
CO5	3	3	3	3	3	3	-	-	-	-	-	3	3	-
Average	3	3	2.83	3	3	3	-	-	-	-	-	2.66	3	-

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**MarksAllotted**
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223015 A: Quantity Surveying (Estimating & Costing)

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week **Practical (CIV223016 A) :02 hrs/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks** **Term work (CIV223016 A): 25 Marks, Oral: 25 Marks**

Prerequisite Courses, if any: - The basic knowledge Building Construction, Concrete Technology Building Drawing, Design of Steel & RCC structures.

Course Objectives:

1 Impart knowledge to prepare approximate estimate
2 Understand the detailed estimate of Civil Engineering works
3 To study the detailed specification and work out rate analysis according to material, labor requirements as per specified norms.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand concept of estimate and mode of measurement.	1-Remember
CO2	Prepare approximate estimate for various for Civil Engineering works.	2- Unserstand
CO3	Prepare detailed estimate of various items of work by using different methods of taking out quantities.	3-Apply
CO4	Apply engineering knowledge to prepare estimate for roads, steel structures, culverts, and water tank.	3-Apply
CO5	Apply concepts of specification to draft brief specification, detailed specification and prepare detailed rate analysis for different items of work	4-Analyze

COURSE CONTENTS

Unit I	**Introduction to Estimating & Costing**	**(08 hrs.)**	**COs Mapped - CO1, CO2.**

Definition of estimation, valuation, purpose, and data required for estimation, types, concept of item of work, different items of work of buildings, units and mode of measurement for different items of work, measurement form and abstract form (Bill of Quantities). Administrative approval and technical sanction, prime cost, provisional sum and provisional quantities, contingencies, rate analysis, lead statement, work charge establishment, centage charges, contents of S. S. R.

Unit II	**Approximate Estimates**	**(07 hrs.)**	**COs Mapped - CO1, CO2**

Methods of approximate estimates & numerical on approximate estimates.

Methods of approximate estimate for Civil Engineering works like building, roads, irrigation, water supply & sanitary works with numericals

Unit III	Detailed estimate	(07 hrs)	COs Mapped –CO2, CO3.

Detailed estimates: factors to be considered while preparing detailed estimate, methods of detailed estimate-PWD and Centre line method, taking out quantities for load bearing and R.C.C framed structures as per IS 1200, bill of quantities. Bar Bending Schedule: introduction to bar bending schedule and its importance, preparing bar bending schedule for RCC members of building.

Unit IV	Estimates of other construction works	(07 hrs)	COs Mapped - CO2, CO3.

Estimate of earthwork for road construction, estimate of road/highway works, estimate of steel roof truss, estimate of a culvert & water tank.

Unit V	Specifications and Rate Analysis	(07 hrs)	COs Mapped - CO1, CO4.

Necessity of specifications, purpose, types, drafting detailed specifications for major items of Civil Engineering works like earthwork, PCC, Masonry (stone & brick), RCC, Plastering, flooring, painting and road, Rate Analysis: purpose, importance, factors affecting rate of an item of work, overheads, task-work, procedure for rate analysis, rate analysis for major items of civil engineering works- like earthwork, PCC, masonry-stone & brick, RCC structural elements, plastering, flooring.

Text Books

1. A Textbook of Estimating and Costing (Civil), D D Kohli and R C Kohli, S. Chand & company, New Delhi.
2 Estimating and Costing in Civil Engineering: Theory and Practice, B. N Dutta and S. Dutta , 28th revised edition, CBS Publishers and distributors
3 Estimating and Costing, R. C. Rangwala, Charotar Publishing House Pvt Ltd, Anand.

Reference Books

1 Estimating, Costing Specifications & valuation in Civil Engineering, M. Chakraborty.
2 A Text Book of Estimating and Costing for Civil Engineering, G.S. Birdie, Dhanpat Rai Publishing Company
3.Estimating and Costing in Civil Engineering: Theory and Practice, B. N Dutta and S. Dutta , 28th revised edition, CBS Publishers and distributors.

Strength of CO-PO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	1	1	-	-	-	2	-	1	-	1	1	-	-	3
CO2	2	1	1	-	-	2	-	1	-	1	1	1	1	3
CO3	3	2	3	2	2	2	1	2	-	3	2	2	2	3
CO4	3	3	3	2	2	2	1	2	-	3	2	2	2	3
CO5	3	3	3	2	2	2	1	2	-	3	2	2	1	3
Average	2.5	2	2.	1	2	2.	1	1.6	-	2	1.6	1.75	1.5	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering):
CIV223015 B:Advanced Fluid Mechanics

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week **Practical (CIV223016 B) :02 hrs/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks** **Term Work: 25 Marks** **Oral Exam (CIV223016 B): 25 Marks**

Prerequisite Courses, if any: -.Fluid Mechanics, Mathematics and Statistics

Course Objectives:

1. To introduce to students the concepts of fluid mechanics from both theoretical and applications perspective.
2. To the platform for fundamental understanding of the basic principles of fluid mechanics

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Know and understand the basic concepts kinematics and Dynamics of fluid flow, Ideal flow, Laminar flow and Turbulent flow, Boundary layer theory, dimensional analysis and model analysis.	1-Remember
CO2	Apply the energy equations for practical problem related to fluid flow.	3-Apply
CO3	Analyze the effect of laminar and turbulent flow and boundary layer for fluid in motion.	4-Analyze
CO4	Carry out dimensional analysis and model analysis for various practical problems.	3-Apply
CO5	Analyze the effect of various fluid properties on flow of fluid.	4-Analyze

COURSE CONTENTS

Unit I	**Properties of Fluids**	**(08 hrs.)**	**COs Mapped - CO1, CO5**

Properties of Fluids: Role of fluid properties in fluid motion, types of fluids based on rheological diagram, Equation of continuity in Cartesian and cylindrical co-ordinate system, Lagrangian and Eulerian approach, stream tube, path lines, streak lines, stream lines and their equations, elements of particle motion, circulation, rotational and irrotational flows, vorticity, angular deformation, stream function, Velocity potential function, Laplace's equation, Flownets.

Unit II	**Dynamics of fluid flow**	**(07 hrs.)**	**COs Mapped - CO1, CO2.**

Dynamics of fluid flow: Equations of Motions, Euler's equation of motion in Cartesian and cylindrical coordinate system,energy equation from Euler's equation, practical applications of energy equation Ideal Flow: uniform flow parallel to x and y axis, source flow, sink flow, Free vortex flows, Superimposed flow: Source and Sink Pair, Doublet, A plane surface flow in a Uniform flow, Source and Sink Pair in Uniform flow

Unit III	**Laminar Flow and Boundary layer**	**(07 hrs)**	**COs Mapped –CO3**

Laminar Flow: Navier-Stokes equation of motion, exact and approximate solutions to Navier-Stokes equation, Relationship between shear stress and Pressure Gradient, Flow of viscous fluid in Circular Pipes-Hagen Poiseuille Law, Flow of viscous fluid between two parallel plates: One plate is moving and other at rest-Couette flow and Both plates at rest Boundary layer theory: boundary layer definitions and characteristics, displacement,

momentum, and energy thickness, Momentum Equation for boundary layer by Von Karman, laminar boundary layer, boundary layer separation and its control			
Unit IV	**Turbulent Flow**	**(07 hrs)**	**COs Mapped - CO4**
Turbulent flow: Charteristics of turbulent flow, Shear stress in turbulent flow: Boussinesq's theory, Reynolds theory, Prandtl's mixing lengththeory, Universal velocitydistribution Hydrodynamically smooth and rough boundaries: velocity distribution for turbulent flow in smooth and rough pipes, Common equation for velocity distribution for both smooth and rough pipes.			
Unit V	**Dimensional Analysis**	**(07 hrs)**	**COs Mapped - CO5, CO1**
Dimensional analysis: dimensions, dimensional homogeneity, Methods of dimensional analysis: Rayleigh's method and Buckingham's pi methods, limitations of dimensional analysis, Model analysis: Similitude, Forces influencing hydraulic phenomenon, dimensionless numbers and their significance, Model Laws, Types of models, Scale effect in models, Limitations of hydraulic similitude			

Text Books

1. Fluid Mechanics: R.K. Bansal
2. Fluid Mechanics and Hydraulic Machines: Modi and Seth

Reference Books

1. R. K. Rajput, (2006) "Fluid Mechanics", S. Chand and Company Limited, New Delhi, Third Edition, ISBN:81-219-1667-4.
2. S. Narsimhan (1973) "Engineering Fluid Mechanics", Orient Longman
3. Douglas J.F, Gasiorek S, waffield J.A. (2003) "Fluid Mechanics", Pearson Education (Singapore) Pvt. Ltd. Indian office at 482 F.I.E. Patparganj, Delhi.
4. Mohanthy A.K. (1994) "Fluid Mechanics, Prentice Hall of India, New Delhi

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	1	-	3	-	-	-	-	-	-	-	-
CO2	-	3	-	2	2	-	-	-	-	3	-	-	-	3
CO3	-	3	3	2	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	3	-	-	-	-	-	-	3	-	-	3
CO5	3	2	-	-	-	3	3	3	-	-	-	-	-	-
Average	3	2.75	2.5	2	2	3	3	3	-	3	3	-	-	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223015 C: Data Analytics

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week **Practical (CIV223016 C) :02 hrs/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks** **Term work (CIV223016 C): 25 Marks** **Practical (CIV223016 C): 25 Marks**

Prerequisite Courses, if any: - Engineering and discrete mathematics, basics of civil engineering

Course Objectives:

1. Impart knowledge and develop the ability of students to analyze the data for a given problem and represent in the mathematical and statistical form.
2. Impart knowledge and develop the ability of students to systematically solve the problems using knowledge of probability, distributions, sampling and formulating hypothesis.
3. Impart knowledge and develop the ability of students to carry out test of hypothesis, and apply the concept of correlation and regression.
4. Impart knowledge and develop the ability of students to understand concept of machine learning and apply Regression, classification and clustering techniques.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand the basic concepts of Statistics and its analysis and applications.	2-Understand
CO2	Solve the problems related to probability and various probability distributions.	3-Apply
CO3	Apply the concept of sampling and distribution and interpret problems using correlation.	3-Apply
CO4	Examine and prepare the data and develop regression model.	3-Apply
CO5	Apply the principles of prediction in data analytics to develop and evaluate predictive models using regression techniques, including multiple linear regression and non-linear regression.	3-Apply

COURSE CONTENTS

Unit I	**Data Analysis**	**(08 hrs.)**	**COs Mapped - CO1, CO2**

Types of data, levels of data, types of variables, data science, data analytics, classification of data analytics, importance of data analytics, central tendency: mean mode, percentile, and dispersion: skewness, kurtosis, range, variance, and coefficient of variation, histogram, scattergram; uncertainty & outliers.

Unit II	**Probability Distribution**	**(07 hrs.)**	**COs Mapped - CO1, CO2**

Introduction to probability and probability distribution, continuous probability distribution: probability density function; normal (Gaussian's) probability distribution; properties of normal curve; lognormal distributions; exponential distribution. Discrete probability distribution: binomial probability, Poisson probability; gamma distribution; case studies: use of dataset/ problems in the field of civil engineering.

Unit III	**Sampling distribution and Correlation**	**(07 hrs)**	**COs Mapped - CO3**
Sample, Types of samples, sample mean, Concept of Sampling Distributions; Impact of Sample Size on Sampling Distribution; Sampling Distribution of the Mean and the Central Limit, sample proportion, sample size determination, Correlation, coefficient of determination, correlation analysis, coefficient of correlation, Rank of correlation.			
Unit IV	**Hypothesis Testing**	**(07 hrs)**	**COs Mapped - CO3, CO4, CO5.**
An estimator or point estimator, confidence interval; estimation of population mean, proportion, cd variance; student's t distribution; chi-square distribution. Confidence interval and hypothesis testing; null and alternative hypotheses; test statistics and rejection regions; critical values; one- or two-tailed test; introduction to type i and type ii errors, P value, F, chi- square, Z and T- test.			
Unit V	**Prediction**	**(07 hrs)**	**COs Mapped - CO4, CO5.**
Data analytics life cycle, data cleaning, data transformation, comparing reporting and analysis, analytical approaches: prediction, regression, general multiple regression model, computation of coefficients of the first order multiple regression model using least square method, non-linear regression, residual analysis.			

Text Books

1. Statistical Methods, 43rd Edition, Gupta S. P, S. Chand Publication.
2. Higher Engineering Mathematics, 42nd edition, Grewal B. S, Khanna Publishers.
3. Machine Learning: Jeeva Jose, Khanna Publishing House, Delhi.

Reference Books

1. Probability and Statistics for Science and Engineering, Rao G. S, Universities press publication.
2. Applied statistics and probability for engineers, Montgomery, Douglas C. and George C. Runger, John Wiley & Sons.
3. Machine Learning, Chopra Rajiv, Khanna Publishing House.

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	-	-	3	-	2	-	-	-	-	1	-	-
CO2	3	3	-	-	3	-	2	-	-	-	-	1	-	-
CO3	3	3	-	2	3	-	2	-	-	-	-	1	1	1
CO4	3	3	3	-	3	3	2	-	-	2	-	1	1	-
CO5	3	3	2	2	3	2	2	-	-	-	-	1	1	-
Average	3	3	2.5	2	3	2.5	2	-	-	2	-	1	1	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223015 D: Finite Element Method

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Theory :03 hrs/week Practical (CIV223016 D) :02 hrs/week	03 01	Continuous Comprehensive Evaluation: 20 Marks In Sem Exam: 20 Marks End Sem Exam: 60 Marks Term work (CIV223016 D): 25 Marks Oral Exam (CIV223016 D): 25 Marks

Prerequisite Courses, if any: - Basics of matrix and matrix operations.

Course Objectives:

1. To learn basic principles of finite element analysis procedure.
2. To learn the theory and characteristics of finite elements that is used in the analysis of engineering structures.
3. To develop the knowledge and skills needed to analyze structural problems by using finite element method.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	Understand the basics of solid mechanics prior to learn finite element analysis.	2-Understand
CO2	Solve simple Engineering problems using 1D, 2D and 3D elements.	2-Understand
CO3	Write shape functions of 1D, 2D and 3D elements.	3-Apply
CO4	Determine the stresses in three dimensional finite elements using isoparametric formulation.	3-Apply
CO5	Analyze the truss and beam elements using stiffness matrix and finite element procedure.	4-Analyse

COURSE CONTENTS

Unit I	**Theory of elasticity**	**(08 hrs.)**	**COs Mapped - CO1, CO2.**

Strain-displacement relations, compatibility conditions in terms of strain, plane stress, plane strain and axisymmetric problems, differential equations of equilibrium, compatibility condition in terms of stresses, stress-strain relations in 2D and 3D problems and Airy's stress function.

Unit II	**Concepts of the finite element method**	**(07 hrs.)**	**COs Mapped - CO1, CO2, CO3.**

General steps of the finite element method, applications and advantages of FEM, concept of finite element for continuum problems, discretisation of continuum, use of polynomial displacement function, Pascal's triangle, convergence criteria, Stability and possible sources of errors, principle of minimum potential energy, formulation of stiffness matrix for truss element using variational principles.

Unit III	**Functions and expressions**	**(07 hrs)**	**COs Mapped - CO1, CO2, CO3**

Displacement function for 2D triangular (CST and LST) and rectangular elements, use of shape functions, area co-ordinates for CST element, shape functions in Cartesian and natural coordinate systems, derivation of expressions for element stiffness matrix and element nodal load vector using principle of stationary potential energy, shape functions for one dimensional element such as truss and

beam, shape functions of 2D Lagrange and serendipity elements.			
Unit IV	**1D, 2D and 3D analysis**	**(07 hrs)**	**COs Mapped - CO4, CO5.**
Introduction to 3D elements such as tetrahedron and hexahedron, theory of isoparametric elements: isoparametric, sub parametric and super-parametric elements, characteristics of isoparametric quadrilateral elements, iso-parametric elements in 1D, 2D and 3D analysis, Jacobian matrix, formulation of stiffness matrix for 1D and 2D Isoparametric elements in plane elasticity problem.			
Unit V	**Stiffness matrix**	**(07 hrs)**	**COs Mapped - CO4, CO5.**
Formulation of stiffness matrix, analysis of spring/bar assemblage, member approach for truss and beam element, node numbering, assembly of element equations, formation of overall banded matrix equation, boundary conditions and solution for primary unknowns, element matrices, assembling of global stiffness matrix, solution for displacements, reactions, stresses, applications to truss and beam not involving unknowns more than three.			

Text Books

1. Introduction to Finite Elements in Engineering, T. R. Chandrupatla and A. D. Belegundu, Prentice Hall Publication
2. A First Course in the Finite Element Method, D. L. Logan, Cengage Publications.

Reference Books

1. Introduction to the Finite Element Method, Desai and Abel, CBS Publishers & Distributors, Delhi
2. Matrix, Finite Element, Computer and Structural Analysis, M. Mukhopadhyay, Oxford IBH Publishing Co. Pvt. Ltd.
3. Finite Element Analysis - Theory & Programming, C. S. Krishnmoorthy, TATA McGraw Hill Publishing Co. Ltd.
4. An Introduction to the Finite Element Method, J. N. Reddy, TATA Mc Graw Hill Publishing Co. Ltd.
5. Theory & Problems -Finite Element Analysis, G. R. Buchanan, Schaum's Outline series. TATA Mc Graw Hill Publishing Co. Ltd.

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	-	-	2	-	1	-	-	-	-	1	-	-
CO2	3	2	-	-	2	-	1	-	-	-	-	1	-	-
CO3	3	2	-	2	2	-	1	-	-	-	-	1	1	1
CO4	3	2	3	-	2	3	1	-	-	2	-	1	1	-
CO5	3	2	2	2	2	2	1	-	-	-	-	1	1	-
Average	3	2	2.5	2	2	2.5	1	-	-	2	-	1	1	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223016 A : Quantity Surveying Lab (Estimating & Costing Lab)

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term work: 25 Marks.** **Oral Exam: 25 Marks**

Prerequisite Courses, if any: - The basic knowledge Building Construction, Concrete Technology Building Drawing, Design of Steel & RCC structures.

Course Objectives:

1. To Study contents of DSR/SSR for rates of different items of work.
2. To use different formats for detailed estimate such as Measurement sheet, Abstract sheet & recapitulation sheet.
3. To apply different methods of taking out quantities for preparation of detailed estimate
4. To draft specification & carry out rate analysis for different items of work.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand contents of DSR/SSR for different items of work	2.Understand
CO2	To calculate quantities of work by diff. methods of taking out quantities.	2. Apply
CO3	Prepare detailed estimate of different civil engineering works.	3.Apply
CO4	Draft detailed specifications and prepare rate analysis report for different items of work	4.Analyze

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Report on study of contents & use of DSR/SSR	**CO1**
2	Detailed estimate of single story load bearing structure	**CO2,CO3**
3	Detailed estimate of (G+1) RCC structure by suitable software	**CO2, CO3**
4	Preparation of detail estimate of other civil works by suitable software	**CO2,CO3**
5	To draft detailed specification important items of work	**CO4**
6	Work out rate analysis according to Specification of item of work by calculating material, labor requirements as per specified norms.	**CO4**

Guidelines for Laboratory Conduction

1. Teacher will explain contents & use of current DSR/SSR
2. Teacher will explain the different methods of taking out quantities.
3. Students will prepare the drawings of load bearing & RCC structure & detailed estimate.
4. Detailed estimates prepared by student will be checked by teacher with corrections.
5. Teacher will explain how to draft specification & prepare rate analysis for different items of work

Guidelines for Student's Lab Journal
Write-up should include the Measurement sheet, Abstract sheet & recapitulation sheet for every detailed estimate with detailed drawings of respective work.
Guidelines for Termwork Assessment
1. Each term work Assignment will be assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223016 B: Advanced Fluid Mechanics Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term Work: 25 Marks** **Oral Exam : 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Engineering Mathematics, Physics and Fluid Mechanics

Course Objectives:

1. To make students aware of the basics of ocean waves.
2. To introduce students to the properties and analysis of waves.
3. To impart knowledge about tides and their dynamic theory.
4. To introduce students to important aspects of long shore transport.
5. To impart knowledge about coastal structures and shore protection.
6. To impart knowledge about coastal management.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand the viscosity of a fluid using suitable viscometer	1. Remember
CO2	Determine the stability of submerged object	`2. Understand
CO3	Evaluate the loss of energy of a flowing fluid in pipe.	3.Apply
CO4	Apply the discharge measurement techniques for practical problems involving fluid flow.	3. Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Measurement of viscosity of fluid by Redwood/Saybolt viscometer.	**CO1**
2	Experimental verification of Bernoulli's theorem with reference to loss of energy.	**CO2**
3	Determination of Stability of Floating Bodies using Ship Model	**CO2, CO4**
4	Determination of Minor Losses in Pipes	**CO4**
5	Determination of Darcy-Weisbach friction factor (f) for a given pipe and study of variation of f with Reynolds Number (Re)	**CO4**
6	Determination of Minor Losses in Pipes	**CO4**
7	Calibration of Venturimeter / Orifice meter.	**CO4**

Guidelines for Laboratory Conduction
1. Teacher will brief the given experiment to students its procedure, tools, and outcome of the practical. 2. Computers and software required for the allotted experiment will be provided by the lab assistants using SOP. 3. Students will perform the allotted practical individually under the supervision of faculty and lab assistant. 4. After performing the practical students will check their images/processing from the teacher. 5. After checking they have to write the outcome of the practical.
Guidelines for Student's Lab Journal
Write-up should include title, aim, diagram, procedure, tools, graphs, symbols, images and questions, if any.
Guidelines for Termwork Assessment
1. Each experiment from lab journal is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223016 C: Data Analytics Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term work :25 Marks** **Oral Exam:25 Marks**

Prerequisite Courses, if any: - The basic knowledge of spreadsheet, Python.

Course Objectives:

1. To enable students to utilize statistical measures such as mean, mode, kurtosis, and coefficient of variation for analyzing Civil Engineering datasets.
2. To familiarize students with the application of probability distributions and sampling techniques in analyzing real-world data sets from Civil Engineering.
3. To equip students with the skills to perform hypothesis testing, correlation analysis, and regression analysis for Civil Engineering datasets using appropriate software tools like Microsoft Excel, Python, or similar platforms.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Determine measures of central tendency, variability, and distribution characteristics of Civil Engineering datasets using statistical techniques and software tools such as Microsoft Excel or Python.	3. Apply
CO2	Demonstrate proficiency in applying these concepts to analyze and interpret data from Civil Engineering datasets, utilizing software platforms like Microsoft Excel or Python.	3. Apply
CO3	Conduct hypothesis testing, correlation analysis, and regression analysis for Civil Engineering datasets, employing appropriate statistical methods and software tools such as Microsoft Excel or Python.	3.Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Determine mean, mode, kurtosis, coefficient of variation.	**CO1,CO2,CO3**
2	Determine measures of central tendency for a Civil Engineering dataset using Microsoft Excel/Python or any other suitable platforms.	**CO1,CO2,CO3**
3	Assignment on continuous probability distribution and discrete probability distribution.	**CO1,CO2,CO3**
4	Assignment on Probability distribution for a Civil Engineering dataset using Microsoft Excel/Python or any other suitable platforms.	**CO1,CO2,CO3**
5	Assignment on Sampling distribution, sample size determination and coefficient of correlation.	**CO1,CO2,CO3**
6	Assignment on Sampling distribution and Correlation for a a Civil Engineering dataset using Microsoft Excel/Python or any other suitable platforms.	**CO1,CO2,CO3**
7	Assignment on test of hypothesis.	**CO1,CO2,CO3**
8	Assignment on test of hypothesis for a Civil Engineering dataset using	**CO1,CO2,CO3**

	Microsoft Excel/Python or any other suitable platforms.	
9	Assignment on Regression for a Civil Engineering dataset using Microsoft Excel/Python or any other suitable platforms.	**CO1,CO2,CO3**

Guidelines for Laboratory Conduction
1. Teacher will brief the given experiment to students its procedure, tools, and outcome of the practical. 2. Computers and software required for the allotted experiment will be provided by the lab assistants using SOP. 3. Students will perform the allotted practical individually under the supervision of faculty and lab assistant. 4. After checking they have to write the outcome of the practical.
Guidelines for Student's Lab Journal
Write-up should include title, aim, numerical and code.
Guidelines for Termwork Assessment
1. Each experiment from lab journal is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223016 D: Finite Element Method Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term work: 25 Marks** **Oral Exam: 25 Marks**

Prerequisite Courses, if any: - Basics of matrix and matrix operations.

Course Objectives:

1. To enable students to understand the theoretical concepts of Finite Element Method (FEM) and its application in solving engineering problems.
2. To develop students' proficiency in formulating stiffness matrices for 1-D and 2-D elements, including the utilization of isoparametric formulation.
3. To familiarize students with the practical implementation of FEM using coding tools and standard software applications for analyzing structural problems.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Apply theoretical principles of FEM to formulate stiffness matrices for various 1-D and 2-D elements, enabling them to solve engineering problems related to structural analysis.	3. Apply
CO2	Demonstrate competence in implementing FEM algorithms using coding tools, thereby enhancing their problem-solving skills and understanding of the computational aspects of FEM.	3. Apply
CO3	Develop proficiency in troubleshooting and debugging FEM models, enhancing their ability to identify and rectify errors in the formulation and implementation of stiffness matrices and boundary conditions.	3.Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	At least one assignment on each unit consisting minimum five numericals/theory questions.	**CO1,CO2,CO3**
2	One assignment based on FEM by using coding tools with program algorithm and flowchart for the following. a) Formulation of stiffness matrix for any 1-D element. b) Formulation of stiffness matrix for any 2-D element using isoparametric formulation.	**CO1,CO2,CO3**
3	Finite Element Method: Software applications of any one cases using suitable standard available software. a) Truss/grid/beam/frame problem. b) Plane stress/plane strain problem.	**CO1,CO2,CO3**

Guidelines for Laboratory Conduction
1. Teacher will brief the given experiment to students its procedure, tools, and outcome of the practical. 2. Computers and software required for the allotted experiment will be provided by the lab assistants using SOP. 3. Students will perform the allotted practical individually under the supervision of faculty and lab assistant. 4. After checking they have to write the outcome of the practical.
Guidelines for Student's Lab Journal
Write-up should include title, aim, numerical and code.
Guidelines for Termwork Assessment
1. Each experiment from lab journal is assessed for thirty marks based on three rubrics. 2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

T. Y. B. Tech.

Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223017: Laws for Engineers

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20 Marks** **In Sem Exam: 20 Marks** **End Sem Exam: 60 Marks**

Prerequisite Courses, if any: - Basic understanding of civil engineering principles and concepts, Familiarity with Indian legal system and terminology.

Course Objectives:

1. To understand the roles and responsibilities of various stakeholders involved in civil engineering projects, including regulatory bodies, standardization organizations, professional bodies, clients, developers, and consultants.
2. To familiarize students with the general principles of contracts management as per the Indian Contract Act, 1972, covering contract formation, types of contracts, contract conditions, tendering process, and contract variations.
3. To provide students with an overview of arbitration mechanisms, including the scope, types, essential elements of arbitration agreements, arbitration tribunal's jurisdiction, and the extent of judicial intervention.
4. To introduce students to the concept of awards and conciliation in dispute resolution, including the form and content of awards, grounds for setting aside awards, enforcement procedures, and the distinction between conciliation, negotiation, mediation, and arbitration.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Identify and explain the respective roles of regulatory bodies, standardization organizations, professional bodies, clients, developers, and consultants in civil engineering projects.	2-Understand
CO2	Develop an understanding of labor engagement methods in civil engineering projects and the compliance requirements of relevant labor laws in India, facilitating effective management of labor relations and legal compliance in engineering projects.	2-Understand
CO3	Demonstrate proficiency in applying the general principles of contracts management as per the Indian Contract Act, 1972, in drafting, negotiating, and managing contracts for civil engineering projects.	3-Apply
CO4	Demonstrate expertise in interpreting and applying contractual provisions, liability rules, and dispute resolution mechanisms under Indian law.	3-Apply
CO5	Analyze and interpret awards in dispute resolution, understand the grounds for setting aside awards, and comprehend the enforcement procedures for domestic and foreign awards.	3-Analyze

COURSE CONTENTS			
Unit I	**Regulatory bodies**	**(08 hrs.)**	**COs Mapped - CO1, CO2**
Respective roles of various stakeholders: Government (constituting regulatory bodies and standardization organizations, prescribing norms to ensure safety of the citizens); Standardization Bodies (ex. BIS, IRC)(formulating standards of practice); professional bodies (ex. Institution of Engineers(India), Indian Roads Congress, IIA/ COA, ECI, Local Bodies/ Planning Authorities) (certifying professionals and offering platforms for interaction); Clients/ owners (role governed by contracts); Developers (role governed by regulations such as RERA); Consultants (role governed by bodies such as CEAI)			
Unit II	**General Principles of Contracts Management**	**(07 hrs.)**	**COs Mapped - CO1, CO2**
Indian Contract Act, 1972 and amendments covering General principles of contracting; Contract Formation & Law; Privacy of contract; Various types of contract and their features; Valid & Voidable Contracts; Prime and sub-contracts; Joint Ventures & Consortium; Complex contract terminology; Tenders, Request For Proposals, Bids & Proposals; Bid Evaluation; Contract Conditions & Specifications, Critical /" Red Flag" conditions; Variations & Changes in Contracts; Differing site conditions; Cost escalation; Delays, Suspensions & Terminations; Time extensions & Force Majeure, Build-Own-Operate & variations; Public- Private Partnerships.			
Unit III	**Arbitration**	**(07 hrs)**	**COs Mapped - CO3**
Arbitration – meaning, scope and types – distinction between laws of 1940 and 1996; UNCITRAL model law – Arbitration and expert determination; Extent of judicial intervention; International commercial arbitration; Arbitration agreements – essential and kinds, validity, reference and interim measures by court; Arbitration tribunal – appointment, challenge, jurisdiction of arbitral tribunal, powers, grounds of challenge, procedure and court assistance.			
Unit IV	**Awards, Conciliation**	**(07 hrs)**	**COs Mapped - CO3, CO4, CO5.**
Award including Form and content, Grounds for setting aside an award, Enforcement, Appeal and Revision; Enforcement of foreign awards – New York and Geneva Convention Awards; Distinction between conciliation, negotiation, mediation and arbitration, confidentiality, resort to judicial proceedings, costs; Dispute Resolution Boards; Lok Adalats.			
Unit V	**Engagement of Labour and Labour Laws**	**(07 hrs)**	**COs Mapped - CO4, CO5.**
Role of Labour in Civil Engineering; Methods of engaging labour- on rolls, labour sub-contract, piece rate work; Industrial Disputes Act, 1947; Collective bargaining; Industrial Employment (Standing Orders) Act, 1946; Workmen's Compensation Act, 1923; Building & Other Construction Workers (regulation of employment and conditions of service) Act (1996) and Rules (1998); RERA Act 2017, NBC 2017.			

Text Books/ Codes

1. B.S. Patil, Legal Aspects of Building and Engineering Contracts, 1974.
2. The National Building Code, BIS, 2017
3. RERA Act, 2017
4. Neelima Chandiramani (2000), The Law of Contract: An Outline, 2nd Edn. Avinash Publications Mumbai

5. Dutt (1994), Indian Contract Act, Eastern Law House

6. Kwatra G.K. (2005), The Arbitration & Conciliation of Law in India with case law on UNCITRAL Model Law on Arbitration, Indian Council of Arbitration.

Reference Books/ Codes/ Papers/ Websites

1. O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers.
2. Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House
3. Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill
4. Internet and Business Handbook, Chap 4, CONTRACTS LAW, http://www.laderapress.com/laderapress/contractslaw1.html
5. Types of Contracts, http://cmsu2.cmsu.edu/public/classes/rahm/meiners.con.ppt

Strength of CO-PO Mapping

	PO												PSO	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	-	3	-	-	3	-	-	-	-	-	-	3	-
CO2	3	-	-	-	-	-	3	3	3	3	-	2	-	-
CO3	-	-	3	-	-	-	-	-	-	-	2	-	-	2
CO4	-	-	3	3	-	-	-	-	-	-	2	-	-	2
CO5	-	-	-	3	-	-	-	-	-	-	2	-	-	2
Average	3	-	3	3	-	3	3	3	3	3	2	2	3	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments on Unit-1 to Unit-4.	15
2	LMS Tests	05
	Total	**20**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223018: Sustainable Structures

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :02 hrs/week	**02**	**Continuous Comprehensive Evaluation: 50 Marks**

Prerequisite Courses, if any: - Understanding of basic civil and environmental engineering.

Course Objectives:

1. To understand green structures and energy efficient materials and their impacts on sustainability
2. To describe different terminologies and engineering concepts involved in smart city.
3. To understand the importance of smart cities with available case studies from India.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Describe the importance of energy and minimization by altering the building materials.	2-Understand
CO2	Understand the importance green Construction and green rating system	2-Understand
CO3	Introduce the applications of energy conservation and efficiency practices in buildings.	2-Understand
CO4	Understand phases and approval involved in smart city project.	2-Understand
CO5	Understand the importance of sustainable development and current protocol of sustainable development goals.	2-Understand

COURSE CONTENTS

Unit I	**Introduction to Embodied Energy**	**(05 hrs.)**	**COs Mapped - CO1**

Introduction to embodied energy, operational energy in building and life cycle energy, ecological foot print, bio-capacity and calculation of planet equivalent, introduction to civil engineering materials with embodied energy minimization concept and utilization

Unit II	**Green Construction Practices**	**(05 hrs.)**	**COs Mapped - CO2**

Introduction to green construction practices, operational energy reduction and net zero building, introduction to optimization for design of building for energy efficiency, examples of optimization, effects of trees and microclimatic modification through greening, importance of rating and rating systems.

Unit III	**Building Integrated Photo Voltaic**	**(05 hrs)**	**COs Mapped –CO3**

Introduction to use of building integrated photo voltaic (BIPV) and other renewable energy in buildings their basic concepts and efficiency, introduction to energy conservation building code (ECBC-2017), mandaroty requirement for comfort system and control and electrical and renewable energy system, introduction to concepts of overall thermal transfer value (OTTV) etc.

Unit IV	**Introduction to Smart Cities**	**(05 hrs)**	**COs Mapped - CO2, CO5.**

Introduction to smart cities, introduction to city planning, dimensions of smart cities, phases, stages of project & their approval status, conventional Vs. smart city components, energy demand, green approach to meet energy demand, index of Indian cities towards smartness, introduction to statistical analysis.

Unit V	**Sustainable Smart City**	**(04 hrs)**	**COs Mapped - CO2, CO5.**

Conventional cities, consequences, alternative resources, reliability on predictability scale, solar options, PV and thermal; singular or hybrid, global experience of smart cities, smart cities, global standards and performance benchmarks, practice codes, India "100 smart cities" policy and mission, smart city planning and development, Swachh Bharat mission and smart cities program, financing smart cities development, smart city case
studies,

Text Books

1. Green Building Materials: A Guide to Product Selection and Specification, 3rd Edition, Ross Spiegel, Dru Meadows
2. Mindful Smart Cities: Rethinking Smart Cities with Mindfulness Engineering, Shima Beigi PhD, VUB PRESS

Reference Books

1. Climate responsive architecture (A design hand book for energy efficient buildings), Arvind Krishnana, Simos Yannas, Nick Baker, S V Szokolay, McGraw hill Education, Seventh reprint.
2. Energy and the Environment, J M Fowler, McGraw Hill, New York, 2nd Edition.
3. Time-Saver Standards For Building Types, Joseph De Chiara, Michael J. Crosbie, McGraw-Hill.
4. Smart Cities: Foundations, Principles, and Applications, Houbing Song, Ravi Srinivasan, Tamim Sookoor, Wiley.
5. Beyond Smart Cities: How Cities Network, Learn and Innovate, Tim Campbell, Routledge.

IS Codes

1. Handbook on functional requirements of buildings (SP41), Bureau of Indian Standards, New Delhi, New Delhi, 1987
2. Energy Conservation Building Code (ECBC), Bureau of energy efficiency, 2017
3. Sustainable Building Design Manual- Volume I & II, TERI, 2009.
4. Green Rating for Integrated Habitat Assessment (GRIHA) guidelines.

Strength of CO-PO Mapping

	PO												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	-	-	3	-	2	-	-	-	-	3	-	-
CO2	3	3	-	-	3	-	2	-	-	-	-	3	-	-
CO3	3	3	-	2	3	-	2	-	-	-	-	3	3	2
CO4	3	3	3	-	3	3	2	-	-	2	-	3	2	-
CO5	3	3	2	2	3	2	2	-	-	-	-	3	2	-
Average	3	3	2.5	2	3	2.5	2	-	-	2	-	3	2.7	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Assignments on Unit-1 to Unit-4.	30
2	LMS Tests	20
	Total	**50**

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223019: Modern Surveying Techniques

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :01 hrs/week **Practical 02 hrs/week**	**01** **01**	**Term work : 25 Marks** **Oral Exam : 25 Marks**

Prerequisite Courses, if any: - The basic knowledge of Surveying, Engineering Mathematic, Physics.

Course Objectives: With the successful completion of the course, the student should have the capability to:

1. Operate a total station to measure distance, angles, and to calculate differences in elevation , receivers and survey grade GNSS instruments,
2. Acquire hands-on experience in collecting survey data using modern instruments and software tools.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Demonstrate proficiency in operating modern surveying instruments such as Total Stations, GPS receivers	2.Understand
CO2	Operate acquire, process, and analyze surveying data obtained from modern instruments using appropriate software	3.Apply

COURSE CONTENTS

Unit I	**Total Station**	**(06 hrs.)**	**COs Mapped - CO1,CO2**

Introduction to EDM:

Introduction, Necessity of Electronic Distance Meter and Digital Theodolite, Electronic Distance Meter, Basic Principle, Principle of Phase Comparison, Classification of EDM Instruments, Basic functions performed by EDM Instruments , Cube Prisms, Methods of Modulation. Operating Procedure

Total Station: Parts of total Station, Advantages and Field Applications, Operating Principle, Special Function in Total station, REM, RDM, etc. Field Procedure for Total Station Survey.

Use of Total station for data processing and analysis, Field work: Point data collection (Easting, Northing and Height), • Electronic Distance Measurement Survey, Area Measurement Survey Height Measurement Survey, Survey Data Post Processing, Survey Data Applications.

Unit II	**Surveying with GPS & DGPS**	**(06 hrs.)**	**COs Mapped - CO2,CO1**

Introduction of GPS: Concepts, Mechanism and Pre requirements of the GPS Survey, Coordinate and time systems, Satellite orbital motions, GPS observables,

System Introduction to Differential GPS (DGPS): Principle, Concepts and Function, Duel and Single Frequency DGPS, RTK and Static Surveys in DGPS, • Use of DGPS in Topographical Survey, Base, Rover, DGPS Connections and Settings. Introduction of Drone surveying, Applications in Civil Engineering.

Text Books

1. Mohinder, S. G., Lawrence, R. W. and Angus, P. A. (2001): Global Positioning Systems, Inertial Navigation and Integration, John Wiley and Sons Inc., New York
2. Satheesh, G., Sathikumar, R. and Madhu, N. (2007): Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson Education, Delhi
3. Satheesh, G., Sathikumar, R. and Madhu, N. (2007): Advanced Surveying: Total Station, GIS and Remote

Sensing, Pearson Education, Delhi

Strength of CO-PO Mapping														
	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	-	1	3	-	-	-	2	-	-	3	2	2
CO2	2	1	-	1	3	-	-	-	2	-	-	3	2	2
Average	2	1	-	1	3	-	-	-	2	-	-	3	2	2

List of Assignments		
Sr. No.	Assignments/Experiments/Practical	CO Mapped
1	Measure distances between two points using the electronic distance measurement (EDM)	CO1,CO2
2	Measure the height of a known object (such as a pole or building) from different locations	CO1,CO2
3	Measure horizontal and vertical angles between points	CO1,CO2
4	Use the Total Station to set out points along a line or at specific distances and angles from a reference point.	CO1,CO2
5	Perform a simple leveling exercise to transfer heights between points using the Total Station.	CO1,CO2
6	Measure the area of a simple polygonal area by taking multiple measurements along its boundary using the Total Station.	CO1,CO2
7	Conduct profile and cross-section surveys along a linear feature (e.g., road, pipeline) using the Total Station.	CO1,CO2
8	Use the Total Station for stakeout purposes by inputting coordinates or distances and angles to locate points on the ground.	CO1,CO2

Guidelines for Practical Conduction

1. Teacher will brief the given assignment to students its procedure, tools, and outcome of the assignment.
2. Computers and software required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will complete the allotted assignment individually under the supervision of faculty.
4. After completing the assignment students will check their images/processing from the teacher.
5. After checking they have to write the outcome of the assignment.

Guidelines for Student's Lab Work

Write-up should include title, aim, diagram, procedure, tools, graphs, symbols, images and questions, if any.

Guidelines for Term work Assessment

1. Each assignment from lab work is assessed for thirty marks based on three rubrics.
2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

T. Y. B. Tech.
Pattern 2022 Semester: VI (B. Tech Civil Engineering)
CIV223020 : Project Phase I

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical :02 hrs/week	**01**	**Tern work: 50 Marks**

Prerequisite Courses, if any: - Fundamentals of Civil Engineering.

Course Objectives:
1. Identify latest technical/practical problems in the field of Civil Engineering.
2. Inculcate the ability to describe, interpret and analyze technical content.
3. Develop competence in preparing report which will enhance critical thinking and develop the skill of technical writing along with presentation.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Demonstrate the ability to perform critical writing by preparing a technical report.	3-Apply
CO2	Review and organize literature survey utilizing technical resources, journals etc	4-Analye
CO3	Evaluate and draw conclusions related to technical content studied.	5- Evaluate
CO4	Develop technical writing and presentation skills.	6-Creating

COURSE CONTENTS

01. Introduction of the topic, its relevance to civil engineering, need for the study, aims and objective, limitations. 02. Literature review from reference books, journals, conference proceedings, published reports/articles/documents with conclusion. The literature review should be from published literature in the last five years. 03. Problem statement and methodology 03. Theoretical contents related to the chosen topic or case studies if applicable. 04. Concluding remarks or summary. 05. References	**COs mapped CO1, CO2, CO3,CO4**

Guidelines for Conduction

Internal guides may prepare a continuous evaluation sheet of each individual and refer as continuous assessment for term work marks. Project group must comprise of minimum two and maximum five students.

Guidelines for Term work Assessment

A continuous assessment will be done by Subject Faculty/Mentor/Guide. Assessment will be based on the Assignments mentioned in the course content.
The students must prepare presentation and report on Project Stage I and present in presence of pair of examiners through a viva-voce examination

Guidelines for Student's Seminar Report

Sequence of pages:
i) Front Cover Page ii) Certificate iii) Acknowledgement iv) Abstract v) Contents vi) List of Figures vii) List of Tables vii) Abbreviations
Chapter 1 Introduction (Introduction , Problem Statement, Objectives , Scope of the Project Works, Expected outcomes)
Chapter 2 Literature Review (It shall include theoretical support, details regarding work done by

Earlier research, methods established any new approach)
Chapter 3 Planning Schedule/ Flow Chart for Completion of Project
Chapter 4 Conclusion
References and Bibliography
Report Printing details:
1. Report shall be typed on A4 size Executive Bond paper with single spacing preferably on **Both** sides of paper.
2. Margins: Left Margin: 37.5 mm, Right Margin: 25 mm, Top Margin: 25 mm, Bottom Margin: 25 mm.
3. Give page number at bottom margin at center.
4. Size of Letters: Chapter Number: 16 font size, Times New Roman in Capital Bold Letters, Chapter Name: 12 Font size in Capital Bold Letters, Main Titles (1.1, 2.5 etc): 16 Font size in Bold Letters Sentence case, Sub Titles (1.1.5, 4.5.1 etc): 14 Font size in Bold Letters Sentence case. All other matter: 12 Font size sentence case.
5. No blank sheet be left in the report.
6. Figure name: 12 Font size in sentence case Bold- Below the figure.
7. Table title -12 font size in sentence case- Bold-Above the table.

Strength of CO-PO Mapping														
	PO												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	2	2	2	2	2	3	3	2	3	3	2
CO2	3	3	3	2	2	2	2	2	3	3	2	3	3	2
CO3	3	3	3	2	2	2	2	2	3	3	2	3	3	2
Average	3	3	3	2	2	2	2	2	3	3	2	3	3	2