



ESTD : 1946

**THE NATIONAL INSTITUTE OF ENGINEERING**  
(An Autonomous Institute under Visvesvaraya Technology University, Belagavi)

## **Detailed Syllabus, 7<sup>th</sup> - 8<sup>th</sup> Sem**

2021 Admitted batch



Department of Civil Engineering

### **VISION**

- The Department will be an internationally recognized centre for value based learning, research and consultancy in Civil Engineering and will produce competent Civil Engineers having commitment to national development.

### **MISSION**

- To impart high quality Civil Engineering education through competent faculty, modern labs and facilities.
- To engage in R & D activities and to provide state-of-the-art consultancy services addressing Civil Engineering challenges of the society.
- To nurture social purpose in Civil Engineers through collaborations.

### **PROGRAMME EDUCATIONAL OBJECTIVES (PEO)**

Civil Engineering graduates are expected to attain the following program educational objectives (PEOs) 3-5 years after graduation. Our graduates will be professionals who will be able to

PEO1: Deliver competent services in the field of Civil Engg., with a knowledge of the principles of engineering and the theories of science that underlie them.

PEO2: Continue their professional development, nurture research attitude, and life-long learning with scientific temperament.

PEO3: Exercise leadership quality and professional integrity, with a commitment to the societal needs and sustainable development.

### **PROGRAMME SPECIFIC OUTCOMES (PSO)**

Graduates from the Department of Civil Engineering will have ability to:

PSO1: Apply basic knowledge of Science & Engineering, and analyze complex Engineering problems to arrive at appropriate solutions in the fields of Civil Engineering;

PSO2: Design & develop sustainable engineering systems by applying state of art tools and techniques, to meet specific needs;

PSO3: Work in a team, as a member or as a leader, with good understanding of finance, management, cultural, societal and legal issues and flair for life long learning.

**PROGRAMME OUTCOMES (PO)**

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.



# **BLOWN UP SYLLABUS**

**2024-25**

**(2021 admitted batch)**

**Department of Civil Engineering**

**TABLE OF SCHEME AND EXAMINATION FOR VII & VIII SEMESTER (2021 admitted batch)**

VII Semester											
Sl. No	Course Code	Course Title	Category	Teaching Hours / Week				Examination			Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self-study Component	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S				
1	21CV7E1X	Professional elective Course-I	PC	3	0	0	0	50	50	100 for each course	12
2	21CV7E2X	Professional elective Course-II									
3	21CV7E3X	Professional elective Course-III									
4	21CV7E4X	Professional elective Course-IV									
5	21CV7AXX	AEC-6 MOOC Elective	AEC	3	0	0	0	50	50	100	3
6	21CV7S01	Technical Seminar	PI	-	-	-	2	50	0	50	1
<b>TOTAL</b>										<b>550</b>	<b>16</b>



VIII Semester											
Sl. No	Course Code	Course Title	Category	Teaching Hours / Week				Examination			Credits
				Theory Lecture	Tutorial	Practical/ Drawing	Self-study Component	CIE Marks	SEE Marks	Total Marks	
				L	T	P	S				
1	21CV8I01	Research/Industry Internship	PI	0	0	8	0	100	100	200	8
2	21CV8P01	Project Work	PI	0	0	8	0	100	100	200	8
				To be completed during 7 <sup>th</sup> semester, evaluation during 8 <sup>th</sup> semester.							
<b>TOTAL</b>										<b>400</b>	<b>16</b>

**List of Professional Elective Course  
For VII Semester**

<b>Professional elective Course - Group I</b>		
<b>Sl. No</b>	<b>Course Code</b>	<b>Course Title</b>
1	21CV7E11	Action and Response of Structural Systems
2	21CV7E12	Dynamics of Structures
3	21CV7E13	Theory of Plates and Shells
4	21CV7E14	Repair and Rehabilitation of Structures
5	21CV7E15	Building Fire Safety
6	21CV7E16	Special Concretes and Construction Chemicals
<b>Professional elective Course - Group II</b>		
<b>Sl. No</b>	<b>Course Code</b>	<b>Course Title</b>
1	21CV7E21	Highway Construction
2	21CV7E22	Ground Improvement Techniques
3	21CV7E23	Pile Foundation Analysis and Design
4	21CV7E24	Reinforced Earth Structures and Geosynthetics
<b>Professional elective Course - Group III</b>		
1	21CV7E31	Wastewater Engineering
2	21CV7E32	Engineering Hydrology
3	21CV7E33	Integrated Watershed Management
4	21CV7E34	Analysis & Design of Water Distribution and Collection Systems
<b>Professional elective Course - Group IV</b>		
1	21CV7E41	Construction Surveying
2	21CV7E42	Geoinformatics for Civil Engineers
3	21CV7E43	Occupational Safety and Health for Civil Engineers





# **DETAILED SYLLABUS VII SEMESTER**



**Code:** 21CV7E11  
**Credits:** 3  
**SEE:** 50%  
**SEE Hours:** 3

**Course:** Action and Response of Structural Systems  
**L: T:P 3:0:0**  
**CIE: 50%**  
**Max. Marks:100**

<b>Prerequisites if any</b>	Design of RC Structures
<b>Learning objectives</b>	The focus of this course is on how to calculate the various design loads, known as actions, which are required to determine the design forces, known as ‘Response’ or effects of actions.

**Course Outcomes:**

*On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Understand the importance of appropriate code provisions	Understand
CO2	Familiarize with procedures for calculating action effects for different types of structures frequently encountered in practice	Apply
CO3	Assess the basic need, concepts and procedures of different types of analysis	Apply
CO4	Characterize the response of different types of structural systems for Tall buildings	Analyze

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2							2					2		
CO2		2		2				2					2		
CO3	2	2		2				2					2		
CO4	2			2				2					2		

**Mapping Strength:**      **Strong- 3**      **Medium - 2**      **Low - 1**

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module - 1: IS 875 PART 1, 2, 4, 5</b>				
1.1	Sources, Nature and Magnitude, Probabilistic assessment, Characteristic and Design values.	2	NA	NA
1.2	IS 875 PART 1 and 2 code provisions. Load combination rules for design.	2	NA	NA
1.3	Estimation of DL and LL on structural elements such as Slab, Beams, Columns, in different types of structural systems, Joint Loads on Trusses, Distributed load on Purlins- Numerical examples.	4	NA	NA
1.4	Accidental loads – Impact and collisions, Explosions and Fire. Numerical examples	2	NA	NA
<b>Module - 2: Wind Load - IS 875 PART 3: Buildings</b>				
2.1	Nature and Magnitude, Factors influencing wind loads, Internal and External pressure distribution, Design Wind Speeds and Pressure	3	NA	NA
2.2	Numerical Examples to calculate external and internal pressure for different types of buildings and regions – Flat roof, Pitched Roof, mono slope roof, Hipped roof, Sign board, Water tank on braced and shaft staging, Multistory Frames	4	NA	NA
<b>Module - 3: Seismic Loads: IS 1893: Buildings</b>				
3.1	Nature and Magnitude, Centre of mass and rigidity	2	NA	NA
3.2	Calculation of Design Seismic Force by Static Analysis Method, Dynamic Analysis Method	2	NA	NA
3.3	Location of Centre of Mass, Location of Centre of Stiffness	2	NA	NA
3.4	Lateral Force Distribution as per code provisions	2	NA	NA
<b>Module - 4: Vehicles Loads as per IRC 6 - 2010 on Road Bridges</b>				
4.1	Class 70 R, Class AA, Class A, Class B, Tracked Vehicle, Wheeled Vehicle	2	NA	NA
4.2	Load Combinations, Impact, Wind, Water Currents	2	NA	NA
4.3	Longitudinal Forces: acceleration, braking and frictional resistance, Centrifugal forces, temperature, Seismic forces, Snow Load, Collision Loads	3	NA	NA
4.4	Load Combinations – Simple Numerical examples	2	NA	NA
<b>Module - 5: Types of Analysis and Behavior of Tall Buildings</b>				



5.1	Linear, Nonlinear behavior, Material nonlinearity, Geometric nonlinearity, Rigid and Elastic Supports	2	NA	NA
5.2	First Order Elastic Analysis, Second Order Elastic Analysis, First order Inelastic Analysis, Second order Inelastic Analysis – Concepts and Brief descriptions	3	NA	NA
5.3	Behavior of Structural forms in Tall buildings –Rigid frame, Braced Frames, Shear Walls, Core walls, Tubular, Belt truss, Outrigger	3	NA	NA
<i>Total No. of Lecture Hours</i>		<b>42</b>		
<i>Total No. of Tutorial Hours</i>			NA	NA
<i>Total No. of Practical Hours</i>				NA

**Textbooks (IS Codes):**

1. IS 875 Parts (1 to 5), IS 1893, IRC 6-2014

**Reference Books:**

1. L. S. Srinath, Advanced Mechanics of Solids, Tata McGraw-Hill Publishing Co, 2010.
2. An explanatory Handbook on IS 875 (PART 3); Wind Load on Building and Structures, Document No: IITKGSDMA Wind 07 V1.0  
IITK-GSDMA Project on Building Codes
3. Explanatory Examples on Indian Seismic Code IS 1893 (Part I): Document No. IITK-GSDMA-EQ21-V2.0 - IITK-GSDMA Project  
Building Codes.
4. Aslam Kassimali, Matrix Analysis of Structures, Cengage Learning, 2012.

**Online Resources:**

<https://www.youtube.com/watch?v=xwIRIGO4e68>

<https://www.youtube.com/watch?v=UHV77TS9X1A>



**Code:** 21CV7E12  
**Credits:** 3  
**SEE:** 50%  
**SEE Hours:** 3

**Course:** Dynamics of Structures  
**L:T:P 3:0:0**  
**CIE: 50%**  
**Max. Marks:100**

<b>Prerequisites if any</b>	Nil
<b>Learning objectives</b>	1. To gain fundamental knowledge on vibration and related systems in the context of Civil Engineering Structures 2. To give exposure on damped and undamped vibratory systems which help in the active control of vibrations in structural systems.

**Course Outcomes:**

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Know the basic principles of dynamics and SDOF Systems.	Understand
CO2	Analyse SDOF systems for their dynamic behaviour	Analyze
CO3	Analyse the system subjected to forced and free vibrations and their significance	Analyze

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	3												3			
CO3			3	3									3	3		
CO4			3	3									3	3		

**Mapping Strength:** Strong- 3 Medium - 2 Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module - 1</b>				
1.1	<b>Fundamentals of vibration:</b> Brief history of vibration, Importance of the study of vibration,	1		
1.2	Basic concepts of vibration, classification of vibrations, vibration analysis procedure,	1		
1.3	Spring elements, mass or inertia elements,	1		
1.4	Damping elements, harmonic analysis.	1		
<b>Module - 2</b>				
2.1	<b>Free vibration of single degree of freedom systems:</b> Introduction, Free vibration of an undamped translational system	1		
2.2	Free vibration of an undamped torsional system	1		
2.3	Stability conditions, Raleigh's energy method,	2		
2.4	Free vibration with viscous damping,	2		
2.5	Free vibration with hysteretic damping.	2		
<b>Module - 3</b>				
3.1	<b>Harmonically excited vibrations:</b> Introduction, Equation of motion,	1		
3.2	Response of an undamped system under harmonic force,	2		
3.3	Response of a damped system under harmonic force,	2		
3.4	Response of a damped system under harmonic motion of the base,	3		
3.5	Response of a damped system under rotating unbalance,	2		
3.6	Forced vibration with coulomb damping,	2		
<b>Module - 4</b>				
4.1	<b>Vibration under general forcing conditions:</b> Response under a general periodic force,	1		
4.2	Response under a periodic force of irregular form,	2		
4.3	Response under a non-periodic force, convolution integral	2		
4.4	Equation of motion for forced vibration for two degree of freedom system	3		
4.5	free vibration analysis of an undamped system for two degree of freedom system	2		



Module – 5				
5.1	<b>Multi-degree of freedom systems:</b> Introduction, Modeling of Continuous systems as multi degree of freedom systems,	2		
5.2	Using Newtons second law to derive equations of motion, Influence coefficients,	2		
5.3	Free and Forced vibration of undamped systems,	2		
5.4	Forced vibration of viscously damped systems.	2		
<i>Total No. of Lecture Hours</i>		42		
<i>Total No. of Tutorial Hours</i>			--	
<i>Total No. of Practical Hours</i>				--

**Self-learning topics identified: (Maximum of 5 topics)**

1. Free vibration of SDOF system with Coulomb damping
2. Vibration of SDOF system subjected to impulse loads
3. Base Isolation techniques

**Textbooks:**

1. Mukyopadhyaya, “Vibration and Structural Dynamics”, Oxford & IBH, 1990.
2. Anil K. Chopra – “Dynamics of Structures” – Theory and application to Earthquake Engineering, Prentice Hall India, 1995.

**Reference Books:**

1. Mario Paz “Structural Dynamics”, CBSPD, 1987
2. Clough R.W. and Penzin J "Dynamics of structures" II Edition, Mcgraw Hill Civil Engineering series, 1993
3. Humar, J. L. Dynamics of Structures, Prentice-Hall, Englewood Cliffs, NJ, 1990.

**Online Resources:**

1. <https://archive.nptel.ac.in/courses/105/104/105104189/>
2. <https://archive.nptel.ac.in/courses/105/101/105101209/>
3. <https://archive.nptel.ac.in/courses/105/101/105101006/>



**Code:** 21CV7E13  
**Credits:** 3  
**SEE:** 50%  
**SEE Hours:** 3

**Course:** Theory of Plates and Shells  
**L:T:P** 3:0:0  
**CIE:** 50%  
**Max. Marks:**100

<b>Prerequisites if any</b>	Structural Analysis
<b>Learning objectives</b>	1. To enable the student analyze thin plates under pure bending and sinusoidal loading for different boundary conditions 2. To analyze the mechanics of shells using generalized concepts of Engineering Mechanics.

**Course Outcomes:**

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Use analytical methods for the solution of thin plates	Analyze
CO2	Apply numerical techniques for the problems in thin rectangular plates.	Apply
CO3	Evaluate the solution for the problems in thin circular plates.	Analyze
CO4	Use analytical methods for the solution of shells	Analyze

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3												3			
CO2	3												3			
CO3			3	3									3	3		
CO4			3	3									3	3		

**Mapping Strength:** Strong- 3 Medium - 2 Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module - 1</b>				
1.1	<b>Bending of Long Rectangular Plates to a Cylindrical Surface</b> Differential equation for cylindrical bending of plates	3		
1.2	Uniformly loaded rectangular plates with simple supported edges	2		
1.3	Rectangular plates with built in edges.	2		
<b>Module - 2</b>				
2.1	<b>Pure bending of plates</b> Slopes - Curvatures of bent plates -	1		
2.2	Relations between bending moments and curvature	2		
2.3	Strain energy in pure bending - Limitations.	2		
2.4	Symmetrical bending of circular plates Differential equation	2		
2.5	Boundary conditions for circular plates	2		
<b>Module - 3</b>				
3.1	<b>Simply supported rectangular plates</b> Rectangular plates under sinusoidal loading Navier's solution	2		
3.2	Application of Navier's solution for concentrated load	3		
3.3	Levy's solution for uniformly distributed load and hydrostatic pressure.	3		
<b>Module - 4</b>				
4.1	<b>Introduction to Shells</b> Definitions; Classification of shells	2		
4.2	Parametric representation of a surface	2		
4.3	The first quadratic form; Equation to the normal of a surface;	2		
4.4	The second quadratic form; Principal curvatures	2		
4.5	Gauss curvature, and lines of curvature;	2		
<b>Module - 5</b>				
5.1	<b>Cylindrical shells</b>	2		



	Membrane theory of cylindrical shells			
5.2	Bending theory of cylindrical shells loaded Symmetrically	2		
5.3	Approximate solution by Schorer's method,	2		
5.4	Beam method of analysis	2		
<i>Total No. of Lecture Hours</i>		42		
<i>Total No. of Tutorial Hours</i>				
<i>Total No. of Practical Hours</i>				

**Self-learning topics identified: (Maximum of 5 topics)**

1. Large deflection theory of plates
2. Mindlin plate theory for thick plates
3. Equation of Equilibrium using Principle of Virtual Work and Boundary Conditions

**Textbooks:**

1. Theory of Plates and Shells, Timoshenko S. and Krieger W., McGraw Hill.
2. Stresses in Plates and Shells, Ugural Ansel C., McGraw Hill.

**Reference Books:**

1. Theory of Plates, Chandrashekhara K., Universities Press.
2. Analysis of plates, T.K. Varadan and K. Bhaskar, Narosa Publishing House
3. Theory and analysis of elastic plates and shells. Reddy, J.N., CRC press.

**Online Resources:**

1. <https://archive.nptel.ac.in/courses/105/103/105103209/>



Code:21CV7E14

Course: Repair and Rehabilitation of Structures

Credits: 3

L:T:P 3:0:0

SEE: 50%

CIE: 50%

SEE Hours: 3

Max. Marks:100

<b>Prerequisites if any</b>	Design of Reinforced concrete structures, Concrete Technology.
<b>Learning objectives</b>	1. To determine causes of deterioration of concrete and steel in structural elements. 2. To Assess existing conditions of buildings. 3. Evaluate structures & suggest methods of repair and strengthening methods.

**Course Outcomes:***On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Investigate the cause of deterioration of concrete structures.	Understand
CO2	Strategies for different repair and rehabilitation of structures.	Apply
CO3	Evaluate the performance of the elements as well as materials for repair.	Apply

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	2		2									3			
CO2	3	2											1			
CO3	3	2	2	2									3	1		

Mapping Strength: Strong- 3 Medium - 2 Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module - 1</b>				
1.1	<b>The Challenge of Renovation / Rehabilitation</b> Terminology, When to Renovate, Beginning a Renovation Project,	2	-	-
1.2	Typical Structural Challenges	2	-	-
1.3	Physical and Chemical Causes of deterioration of concrete structures	2	-	-
1.4	Evaluation of structural damages to the concrete structural elements due to earthquake.	2	-	-
<b>Module - 2</b>				
2.1	<b>Damage Assessment:</b> Purpose of assessment, Rapid assessment	2	-	-
2.2	Investigation of damage, Evaluation of surface and structural cracks	2	-	-
2.3	Damage assessment procedure, Destructive tests	2	-	-
2.4	Non-destructive tests and semi destructive testing systems	2	-	-
<b>Module - 3</b>				
3.1	<b>Repairing Deteriorated Concrete</b> Overview, Cracks in concrete and Repairing cracks.	2	-	-
3.2	Corrosion of Reinforcement and its Effects on concrete, Patching spalls and Deteriorated Areas.	2	-	-
3.3	Cathodic and Anodic – Protection and Electrochemical Chloride Extraction.	2	-	-
3.4	Corrosion Inhibitors, Other types of Damage to concrete.	2	-	-
3.5	Materials for concrete Repair, Durability of Repairs.	2	-	-
<b>Module - 4</b>				
4.1	<b>Rehabilitation of Concrete Structures</b> Method of repair & restoration – patch repair, pressure grouting, guniting shotcreting.	1	-	-
4.2	Retrofitting of structural members i.e., column and beams by Jacketing technique.	2	-	-
4.3	Externally bonding (ERB) technique, near surface mounted (NSM) technique.	2	-	-

4.4	External post- tensioning, Section enlargement and guidelines for seismic rehabilitation of existing building.	2	-	-
<b>Module – 5</b>				
5.1	<b>Renovating Steel-Framed Buildings</b> Steel: The Venerable Material, Past Design Methods and Allowable Stresses for iron and steel Beams.	2		
5.2	Early Iron and Steel Columns, Properties of Early Fasteners, Open- Web Joists, Strengthening Floors.	2		
5.3	Reinforced Steel Members by Welding, Reinforced Beams by Composite Action with Concrete, Strengthening Beams Connections.	3		
5.4	Composite Steel-Concrete Columns, Openings in Existing Steel Beams, Thermal Prestressing of Steel Structures.	2		
<i>Total No. of Lecture Hours</i>		42		
<i>Total No. of Tutorial Hours</i>			--	
<i>Total No. of Practical Hours</i>				--

**Textbooks:**

1. Newman, Alexander. Structural Renovation of Buildings Methods, Details, and Design Examples. McGraw Hill, 2021.
2. Johnson, Sidney M. Deterioration, Maintenance, and Repair of Structures. R.E. Krieger Pub. Co., 1981.
3. Campbell-Allen, Denison, and Harold Roper. Concrete Structures: Materials, Maintenance and Repair. Harlow, Essex, 1991.

**Reference Books:**

1. R.T. Allen and S.C. Edwards, “Repair of Concrete Structures”-
2. Blakie and Sons Raiker R.N., “Learning for failure from Deficiencies in Design, Construction and Service” - R&DCentre (SDCPL).

**Online Resources:**

1. NPTEL Course: <https://archive.nptel.ac.in/courses/105/105/105105213/>



Code:21CV7E15

Course: Building Fire Safety

Credits: 3

L:T:P 3:0:0

SEE: 50%

CIE: 50%

SEE Hours: 3

Max. Marks:100

<b>Prerequisites if any</b>	Design of Reinforced concrete structures
<b>Learning objectives</b>	1. To determine causes of accidental fires leading to various fire spread scenarios 2. To understand the fire safety measure under building fire.

**Course Outcomes:**

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Describe the concepts of fire severity and fire resistance	Understand
CO2	Design fire detection and suppression system to limit fire exposure	Apply

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	2		2									3	1		
CO2	3	2	2										3	1		

Mapping Strength: Strong- 3 Medium - 2 Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module - 1</b>				
1.1	<b>Fire Safety in Buildings:</b> Fire safety objectives: Life safety, Property protection and Environmental protection.	2	-	-
1.2	Process of Fire development: Fire behavior,	2	-	-
1.3	Factors affecting the growth phase, human behavior,	1	-	-
1.4	Detection and control of the fire. Fire resistance: Objectives for fire resistance, Examples of Fire resistance, Fire design time, trade-offs.	1	-	-
<b>Module - 2</b>				
2.1	<b>Fire Spread and Control</b> Causes of Fire spread. Controlling fire spread fire spread within room of origin,	2	-	-
2.2	Compartmentation, Fire spread to adjacent rooms,	1	-	-
2.3	Fire spread to other storeys, and Fire spread to other buildings,	1	-	-
2.4	Building construction for fire safety, Fire following earthquake, Fire during construction and alterations.	2	-	-
<b>Module - 3</b>				
3.1	<b>Fire and Heat</b> Combustion, Fire Initiation: Sources and Mechanisms, Pilot Ignition and Auto-ignition,	1	-	-
3.2	Flame Spread. Pre-flashover Fires: Burning Items in Open Air,	1	-	-
3.3	Burning Items in Rooms, t-Squared Fires, Fire Spread to Other Items,	2	-	-
3.4	Calculation of fire load, Pre-flashover Fire Calculations. Conditions Necessary for Flashover	2	-	-
3.5	Numerical on design fires	4	-	-
<b>Module - 4</b>				
4.1	<b>Design of Detection Systems:</b> Detection System Design, Types of Detectors, Manual Detection.	2	-	-
4.2	Heat Detectors, Fixed Temperature Detectors, Smoke Detectors,	2	-	-
4.3	Detection Calculation Methodologies and Numerical on detection design	3	-	-
4.4	Suppression System Design and Numerical on suppression system design	3	-	-
<b>Module - 5</b>				
5.1	Design of sprinklers systems: Types of Sprinkler Systems, Pressure Requirements of the Most Remote Sprinkler, Pressure Losses Through Piping, Fittings, and Valves	2		
5.2	Use of Velocity Pressures, Elevation Losses, Loops and Grids	2		



5.3	Water Supply Calculations: Determination of Available Supply Curve, Pump Selection and Testing, Tank Sizing	3		
5.4	Performance Calculations: Sprinkler Response as a Detector, Dry System Water Delivery Time	3		
<i>Total No. of Lecture Hours</i>		42		
<i>Total No. of Tutorial Hours</i>			--	
<i>Total No. of Practical Hours</i>				--

**Textbooks:**

1. Andrew H. Buchanan, “**Structural Design for Fire Safety**” John Wiley & Sons. Ltd, 2001.

**Reference Books:**

1. Hurley, Morgan J., and Eric R. Rosenbaum. Performance-Based Fire Safety Design. CRC Press, 2019.
2. SFPE Handbook of Fire Protection Engineering. Springer, 2016.



Code: 21CV7E16

Course: Special Concretes and Construction Chemicals

Credits: 3

L:T:P 3:0:0

SEE: 50%

CIE: 50%

SEE Hours: 3

Max. Marks:100

<b>Prerequisites if any</b>	Concrete Technology
<b>Learning objectives</b>	1. To acquire knowledge on various new types of concrete 2. To be able to identify usage of construction chemicals.

**Course Outcomes:***On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Describe specification of various new age concrete	Understand
CO2	Describe advantages of property modifying chemical used during construction	Apply

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												3		
CO2		3	3											3	

Mapping Strength: Strong- 3 Medium - 2 Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module – 1</b>				
1.1	Review of Concrete Technology: Components of modern concrete and developments in the process and constituent materials	03	-	-
1.2	Role of constituents, Development in cement, and cement replacement materials, pozzolona, fly ash, silica fume, rice husk ash, recycled aggregates.	03	-	-
<b>Module – 2</b>				
2.1	Light Weight Concrete-Introduction, classification, properties	03	-	-
2.2	Light Weight Concrete-strength and durability, mix proportioning	03	-	-
2.3	High Density Concrete-Radiation shielding ability of concrete, materials for high density concrete,	03	-	-
2.4	High Density Concrete-mix proportioning, properties in fresh and hardened state, placement methods.	03	-	-
<b>Module – 3</b>				
3.1	Ferro Cement: Ferrocement materials, mechanical properties, cracking of ferrocement, strength and behavior in tension,	03	-	-
3.2	compression and flexure, Design of ferrocement in tension, Ferrocement constructions, durability.	03	-	-
3.3	Fibre Reinforced Concrete: Fibre materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state,	03	-	-
3.4	strength and behavior in tension, compression and flexure of steel fibre reinforced concrete, mechanical properties, Crack arrest and toughening mechanism.	03	-	-
<b>Module – 4</b>				
4.1	High Performance Concrete: constituents, Properties in fresh and hardened states, applications and limitations.	02	-	-
4.2	Ready Mixed Concrete-QCI-RMCPC scheme requirements	02	-	-
4.3	Self Compacting Concrete (SCC) - general characteristics, properties, microstructure, robustness, and	02	-	-

	Methods of mix proportioning, and its applications.			
4.4	Reactive Powder Concrete: Introduction, Polymers Concrete: Introduction and types.	02		
<b>Module – 5</b>				
5.1	Introduction on Chemical and Mineral Admixtures; Accelerators; Retarders; Plasticizers: Introduction, Categories, Chemical Composition and Manufacture of Water Reducers; use of water reducers/retarders;	02	-	-
5.2	Superplasticizers: Background and definitions, the chemistry of superplasticizers Effects of superplasticizers on the properties of concrete.	02	-	-
<i>Total No. of Lecture Hours</i>		<b>42</b>		
<i>Total No. of Tutorial Hours</i>			<b>00</b>	
<i>Total No. of Practical Hours</i>				<b>00</b>

**Self-learning topics identified: (Maximum of 5 topics)**

1. Mix proportioning of Concrete per IS 10262: 2019
2. Application of Light Weight Concrete and High Density Concrete
3. Applications of FRC and Ferro Cement
4. Bacterial Concrete Constituents

**Textbooks:**

1. Shetty M. S., “Concrete Technology - Theory & Practice”, S. Chand and Company, New Delhi-2002

**Reference Books:**

1. N. Krishnaraju., “Concrete mix Design”, Sehgal Publishers 2009.
2. Neville, A.M., “Properties of Concrete”, ELBS, London 2000.
3. Ramachandran, V.S., “Concrete admixtures handbook: properties, science and technology”, William Andrew 1996.
4. Roger Rixom and Noel Mailvaganam., “Chemical admixtures for concrete”, 3rd edition, CRC Press, 1999
5. Relevant IS codes

**Online Resources:**

1. [Development and Applications of Special Concretes - Course \(nptel.ac.in\)](https://www.nptel.ac.in/courses/112102002/)
2. [Admixtures And Special Concretes - Course \(nptel.ac.in\)](https://www.nptel.ac.in/courses/112102002/)
3. [Concrete Technology - Course \(swayam2.ac.in\)](https://www.swayam2.ac.in/courses/112102002/)



**Code:** 21CV7E21  
**Credits:** 3  
**SEE:** 50%  
**SEE Hours:** 3

**Course:** Highway Construction  
**L:T:P** 3:0:0  
**CIE:** 50%  
**Max. Marks:**100

<b>Prerequisites if any</b>	Highway Engineering
<b>Learning objectives</b>	1. To acquire knowledge on various pavement materials 2. To be able to identify usage of highway construction equipment's.

**Course Outcomes:**

*On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Describe specification of various pavement materials and functions of highway construction equipment's.	Understand
CO2	Describe functions of component layers and construction methods of flexible and rigid pavements.	Apply

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	03												03		
CO2		03	03											03	

**Mapping Strength:** Strong- 3 Medium - 2 Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module – 1</b>				
1.1	Highway construction materials: Requirements, properties and tests on Road aggregates, Concepts of size and gradation	03	-	-
1.2	Design gradation, maximum aggregate size, aggregate blending by different methods to meet specification	03	-	-
1.3	Bitumen, Tar, Emulsion and Cutback - Properties and Requirements	03	-	-
<b>Module – 2</b>				
2.1	Equipment's in highway construction: Various types of equipment's for excavation, grading and compacting- their working principles, advantages and limitations.	03	-	-
2.2	Special equipment for bituminous and cement concrete pavement	03	-	-
2.3	Pavement repair and maintenance equipment's	03	-	-
<b>Module – 3</b>				
3.1	Subgrade: Properties of soil subgrade, HRB soil classification	03	-	-
3.2	Evaluation of strength of subgrade, Earthwork grading and Construction of embankments and cuts for roads	03	-	-
3.3	Preparation of subgrade, quality control tests	03	-	-
<b>Module – 4</b>				
4.1	Construction of flexible pavement: Specifications of materials, Component layers and their functions	03	-	-
4.2	Construction of Granular sub base course, granular base / sub-base courses such as WBM, WMM, and CRM bituminous binder course (BM & DBM).	03	-	-
4.3	Common types of bituminous surfacing courses such as surface dressing, premixed carpet (PMC) and bituminous concrete, Field control checks.	03	-	-
<b>Module – 5</b>				
5.1	Construction of rigid pavement: Specifications and method of cement concrete pavement construction	02	-	-
5.2	PQC, importance of providing DLC as sub base and polythene thin layer between PQC and sub base	02	-	-
5.3	Quality control tests, Construction of various types of joints	02	-	-



<i>Total No. of Lecture Hours</i>	<b>42</b>		
<i>Total No. of Tutorial Hours</i>	<b>00</b>		
<i>Total No. of Practical Hours</i>	<b>00</b>		

**Self-learning topics identified: (Maximum of 5 topics)**

5. Sustainable pavement materials.
6. Stresses in rigid pavements

**Textbooks:**

1. Highway Engineering-Khanna and Jasto and Veeraragavan
2. Construction Equipment's and its management- Sharma, S.C. Khanna publishers

**Reference Books:**

1. Relevant IRC codes and MORTH specification

**Online Resources:**

4. <https://morth.nic.in/national-highway-details>
5. <https://nhidcl.com/>



**Code:** 21CV7E22 **Course:** Ground Improvement Techniques  
**Credits:** 3 **L:T:P:** 3:0:0  
**SEE:** 50% **CIE:** 50%  
**SEE Hours:** 3 **Max. Marks:** 100

<b>Prerequisites if any</b>	Geotechnical Engineering
<b>Learning objectives</b>	To understand the need for ground improvement techniques and to know the various ground improvement used for different civil engineering projects

**Course Outcomes:**

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	To understand the need of ground improvement techniques	Understand
CO2	To analyze the field compaction techniques	Understand, Apply Analyze
CO3	To understand the chemical stabilization and grouting of soil	

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	2											2	
CO2		3		1		1							3		1
CO3	2						3							1	

**Mapping Strength:** Strong- 3 Medium - 2 Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module – 1</b>				
<b>Introduction to Ground Improvement Techniques</b>				
1.1	Principles and objectives of ground improvement; History of ground improvement developments.	03		
1.2	Classification of ground improvement techniques. Factors affecting ground improvement.	03		
1.3	Mechanical modification method of ground improvement	03		
<b>Module – 2</b>				
<b>Field Compaction Techniques</b>				
2.1	Field compaction, Equipment for field compaction: smooth wheel rollers, pneumatic rollers, sheep foot rollers, grid rollers, Power rammers. Role of vibrations in dynamic compaction; Dynamic Field Compaction Equipment: Impact type of compaction	04		
2.2	Vibratory compressors for deep compaction, compaction piles, vibroflotation, underground blasts	03		
<b>Module – 3</b>				
<b>Chemical Stabilisation of soil</b>				
3.1	Chemical Modification: Factors affecting chemical modification	03		
3.2	Lime stabilization, Cement stabilization, Bitumen stabilization	03		
3.3	Stabilization with industrial by products	03		
<b>Module – 4</b>				
<b>Grouting Techniques</b>				
4.1	Grouting: Factors affecting grouting	03		
4.2	Groutability, Grouting materials and their properties	03		
4.3	Pressure grouting, Compaction grouting, Grouting procedures	02		
4.4	Applications of grouting	02		
<b>Module – 5</b>				
<b>Applications of Geosynthetics</b>				
5.1	Applications of Geosynthetics for ground improvement	05		
<b>Total No. of Lecture Hours</b>		<b>40</b>		
<b>Total No. of Tutorial Hours</b>			<b>00</b>	

**Self-learning topics identified:**

1. Rock Cutting
2. Anchoring
3. Heating
4. Soil Nailing

**Textbooks:**

Hausmann, M R (1990) "Engineering Principles of Ground Modifications", McGraw Hill Pub Co New York.

**Reference Books:**

1. Manfired R.H. (1990) "Engineering Principles of Ground Modification", McGraw-Hill Pub.
2. Belt (1975) "Methods of Treatment of Unstable Ground", Butterworths.
3. Koener R M. (1985) "Construction and Geotechnical Methods in Foundation Engineering"., McGraw Hill Pub Co New York.
4. Ingles O G and Metcalf J B., "Soil Stabilisation: Principles and practice", Butterworths, London, 1972
5. Ell F G., "Methods of Treatment of Unstable ground, Newness Butterworths, London, 1975.
6. Rao, G. V. and Raju, V. V. S. (1990), "Engineering with geosynthetics", Tata McGraw Hill Book Co., New Delhi.
8. Nelson J D and Miller D J., "Expansive soils", John Wiley and sons. Inc new

**Online Resources:**

1. <https://nptel.ac.in/courses/105108075>
2. <https://archive.nptel.ac.in/courses/105/105/105105210/>
3. <https://geotechnical-library.geotill.com/Ground-Improvement-Techniques-by-N.R.-Patra.pdf>



**Code:** 21CV7E23 **Course:** Pile Foundation Analysis and Design  
**Credits:** 3 **L: T: P: 3:0:0**  
**SEE:** 50% **CIE: 50%**  
**SEE Hours:** 3 **Max. Marks: 100**

<b>Prerequisites if any</b>	Geotechnical Engineering
<b>Learning objectives</b>	To understand the basic principles of pile foundation and design the pile capacity for various soil profiles

**Course Outcomes:**

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	To understand the need for pile foundation	Understand
CO2	To evaluate pile capacity of single pile and pile group by static equations and dynamic equations	Understand, Apply Analyze
CO3	To design the under-reamed pile and understand the properties of expansive soil	Design, Understand, Apply

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	1										3		
CO2	1	2	3											1	3
CO3	2				1								2		1

**Mapping Strength:** Strong– 3 Medium – 2 Low – 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module – 1</b>				
<b>Introduction to Ground Improvement Techniques</b>				
1.1	Need for Pile Foundation	03		
1.2	Pile Foundation: Classification	03		
1.3	Pile Foundation: Applications	03		
<b>Module – 2</b>				
<b>Field Compaction Techniques</b>				
2.1	Single Pile Capacity Evaluation by Static Formulas - Cohesive and Cohesionless soil	03		
2.2	Pile Group Capacity Evaluation by Static Formulas	03		
2.3	Evaluation of Pile Group Efficiency	02		
<b>Module – 3</b>				
<b>Chemical Stabilisation of soil</b>				
3.1	Pile Capacity by Dynamic Equations	03		
3.2	Pile Capacity by Pile Load Tests: Compressive Load, Lateral Load	03		
3.3	Pile Capacity by Correlation with Field Test Data	03		
<b>Module – 4</b>				
<b>Grouting Techniques</b>				
4.1	Foundations in problematic soils	03		
4.2	Identification of expansive soils	03		
4.3	Under-ream piles: Determination of pile capacity for compressive and uplift loads	03		
<b>Module – 5</b>				
<b>Applications of Geosynthetics</b>				
5.1	Pile testing: Integrity of piles, corrosion resistance, durability, damage protection to wooden and concrete piles.	03		
5.2	Case studies on failure of piles	02		
<b>Total No. of Lecture Hours</b>		<b>40</b>		
<b>Total No. of Tutorial Hours</b>			<b>00</b>	

**Self-learning topics identified:**

1. Pile Foundations for Offshore Structures
2. Pile Driving Analysis
3. Franki piles
4. Pile Raft foundation

**Textbooks:**

VNS Murthy “Advanced Foundation Engineering”, CBS Publisher (2017)

**Reference Books:**

1. Tomlinson M j., “Foundation design and construction”-sir Isac Pirman & sons Ltd. London (1963) 1<sup>st</sup> edition
2. Poulos and Davis. “Pile foundation analysis and design”- Elastic solution for soil & Rock Mechanics. John Wiley sons. (1974)
3. Chellis R.D., “Pile foundation – Theory – Design – Practice”- McGraw Hill (1963)
4. Bowels J.E., “Analytical and computer methods in foundation engineering” (1974)
5. Willkern and Fang., “Foundation engineering Hand Book”-Von No strand and remhold Co (1975)

**Online Resources:**

1. <https://archive.nptel.ac.in/courses/105/105/105105207/>
2. <https://archive.nptel.ac.in/courses/105/108/105108069/>



**Code:** 21CV7E24  
**Credits:** 3  
**SEE:** 50%  
**SEE Hours:** 3

**Course:** Reinforced Earth Structures and Geosynthetics  
**L:T:P:** 3:0:0  
**CIE:** 50%  
**Max. Marks:** 100

<b>Prerequisites if any</b>	Geotechnical Engineering
<b>Learning objectives</b>	To understand the concepts of reinforced earth technology and understand the applications of geosynthetic products in various civil engineering projects.

**Course Outcomes:**

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	To understand the reinforced earth structure concept and need for geosynthetics	Understand
CO2	To analyze the properties and functions of various geosynthetic products	Understand, Apply Analyze
CO3	To analyze the applications of various geosynthetic products in slope, pavement, foundation and MSE wall	

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		2				1						1		3
CO2		2		1		2								2	
CO3			2	2			3						1		2

**Mapping Strength:** Strong– 3 Medium – 2 Low – 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module – 1</b>				
<b>Introduction to Reinforced Soil Structures</b>				
1.1	Historical background	02		
1.2	Need for Geosynthetics	02		
1.3	Comparison with reinforced cement concrete structures	02		
1.4	Principles, Concepts and Mechanisms of reinforced earth	02		
<b>Module – 2</b>				
<b>Types and Properties of Geosynthetics</b>				
2.1	Material properties, laboratory testing and manufacturing details of Geosynthetics	04		
2.2	Geotextiles, Geogrids, Geonet, Geomembranes, Geocell	02		
2.3	Geocomposites, GCL	02		
<b>Module – 3</b>				
<b>Applications of reinforced soil structures</b>				
3.1	Application of reinforced soil structures in the design of Pavements	03		
3.2	Application of reinforced soil structures in the design of Slopes and Foundations	03		
3.3	Reinforced soil structures for soil erosion control problems	03		
<b>Module – 4</b>				
<b>Design of MSE Wall</b>				
4.1	Design of MSE Wall using Geotextile and Geogrid	06		
<b>Module – 5</b>				
<b>Case Studies of Applications of Geosynthetics</b>				
5.1	Applications of Geosynthetics in Geoenvironmental engineering	03		
5.2	Application of Geosynthetics in various Civil Engineering projects	03		
5.3	Case studies on Application of Geosynthetics	03		
<b>Total No. of Lecture Hours</b>		<b>40</b>		
<b>Total No. of Tutorial Hours</b>			<b>00</b>	
<b>Total No. of Practical Hours</b>				<b>00</b>

**Self-learning topics identified:**

1. Application of reinforced soil structures in the design of Embankments
2. Metallic strips and Metallic grids
3. PVD's
4. Geofabric

**Textbooks:**

1. Koerner R M., "Designing with Geosynthetics, Volume-1", 6<sup>th</sup> Edition, Prentice- Hall pub 2012.
2. Koerner R M., "Designing with Geosynthetics, Volume-2", 6<sup>th</sup> Edition, Prentice- Hall pub 2012.

**Reference Books:**

1. Sanjay Kumar Shukla, Jian-Hua Yin, "Fundamentals of geosynthetic engineering", CRC Press; 1st ed (2014)
2. Jones C.J.E P., "Earth Reinforcement and soil structures", Butterworth's, London, 1996.
3. Koerner R.M., and Welsh. J P., "Construction and Geotechnical Engineering using synthetic Fabric", Wiley Interscience, New York, 1980
4. Jonathan T. H. Wu, "Geosynthetics Reinforced Soil (GRS) walls", Wiley-Blackwell; 1st edition (2019)
5. Ingod T S., "Reinforced Earth", Thoms Telford publications, London

**Online Resources:**

1. <https://archive.nptel.ac.in/courses/105/106/105106052/>
2. <https://archive.nptel.ac.in/courses/105/101/105101143/>



**Code:** 21CV7E31  
**Credits:** 3  
**SEE:** 50%  
**SEE Hours:** 3

**Course: Wastewater Engineering**  
**L:T:P 3:0:0**  
**CIE: 50%**  
**Max. Marks:100**

<b>Prerequisites if any</b>	Water Supply and Treatment
<b>Learning objectives</b>	<ol style="list-style-type: none"> <li>To understand and design the various components of sewerage system by calculating the sewage generated.</li> <li>To understand and design unit operations and unit process involved in Sewage treatment plant by studying the various characteristics of wastewater.</li> <li>To understand the importance of recycle and reuse of wastewater by proper designing the disposal system in sewered and unsewered areas.</li> </ol>

**Course Outcomes:**

*On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Estimate sewage generation and to design and detail the components of sewerage system.	Understand & apply
CO2	Characterize wastewater and to plan and design a complete sewage treatment scheme.	Understand & apply
CO3	Design and detail the disposal system in sewered and unsewered areas with emphasis on recycle and reuse.	Understand & apply

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1		3									1	3	
CO2		3											1	3	
CO3			3										3		

**Mapping Strength:** Strong- 3      Medium - 2      Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module - 1</b>				
1.1	<b>Introduction:</b> Need for sanitation, methods of sewage disposal, sewerage systems - classification and suitability. Dry weather flow, wet weather flow, factors effecting dry and wet weather flow on design of sewerage system,	03		
1.2	<b>Wastewater Flow Rates</b> Computation of design flow, Storm flow - estimation through rational method (inclusive of concepts of Time of concentration, use of rainfall intensity curves, etc.) and empirical formulae	03		
1.3	<b>Sewers and Storm Water Drains</b> Hydraulic formulae for velocity, effects of flow variations on velocity, self-cleansing and non-scouring velocities, Hydraulic elements for circular sewers flowing full and flowing Partially full. Storm water drains.	03		
<b>Module - 2</b>				
2.1	<b>Sewers Construction &amp; Maintenance</b> Sewer materials, shapes of sewers, laying and testing of sewers, ventilation and cleaning of sewers.	03		
2.2	<b>Sewer Appurtenances</b> Manholes catch basins, street inlets, oil and Grease traps, wet wells and design of pumping stations.	02		
2.3	<b>Drainage in Buildings</b> Basic principles of drainage in buildings, Pipes, traps and sanitary fittings, typical layout plan showing house drainage connections	02		
<b>Module - 3</b>				
3.1	<b>Waste Water Characterization</b>	03		



	Physical, Chemical and Biological characteristics, Aerobic and Anaerobic activity. BOD and COD, their significance & limitations			
3.2	<b>Municipal Sewage Treatment</b> Flow diagram of municipal sewage treatment plant.	02		
3.3	<b>Primary Treatment</b> Screening, Grit chambers, Primary sedimentation tanks, (Design criteria & Design examples)	03		
<b>Module – 4</b>				
4.1	<b>Secondary Treatment</b> Suspended growth - Activated sludge process- Principle and flow diagram. Design of ASP, Modifications of ASP,	03		
4.2	Fixed film bioprocess- Trickling filter – theory and operation, types and designs.	03		
4.3	<b>Treatment and Disposal of Sludge</b> Anaerobic Sludge digestion, Sludge digestion tanks, Sludge drying bed	03		
<b>Module – 5</b>				
5.1	<b>Disposal of effluents:</b> Dilution, self-purification phenomenon, oxygen sag curve, zones of purification, sewage farming, sewage sickness,	03		
5.2	Numerical problems on disposal of effluents. Streeter-Phelp's equation.	03		
5.3	<b>Low-Cost Sewage Treatment (Isolated Buildings and Small Communities)</b> Septic tank and soak pits, Stabilization ponds, <b>Reuse and Recycle of Waste Water</b> Disinfection of sewage by chlorination, direct and indirect reuse of wastewater – Municipal, Industrial, Agriculture, Recreational, and Groundwater reuse.	03		
<b>Total No. of Lecture Hours</b>		42		
<b>Total No. of Tutorial Hours</b>				
<b>Total No. of Practical Hours</b>				

**Self-learning topics identified:**

1. Systems of plumbing
2. Onsite Sanitation

**Textbooks:**

1. Metcalf & Eddy “**Wastewater Engineering treatment and reuse**” Mcgraw Higher Edition 2002.

**Reference Books:**

1. Howard S. Peavy, Donald R. Rowe, George T, Environmental Engineering-Tata McGraw Hill, New York, Indian Edition, 2013
2. Hammer, M.J. and Hammer, M.J.Jr. “**Water and waste Water Technology**”, 6<sup>th</sup> Edition, Prentice Hall, Inc., New Jersey, 2007.

**Online Resources:**

1. <https://archive.nptel.ac.in/courses/105/105/105105178/> NPTEL MOOC course on “**Wastewater Treatment and Recycling**”, Prof. M.K.Tiwari
2. <https://nptel.ac.in/courses/105107207> NPTEL MOOC course on “**Water and waste water treatment**” Prof. Bha Prakash Vellanki.



**Code:** 21CV7E32  
**Credits:** 3  
**SEE:** 50%  
**SEE Hours:** 3

**Course: Engineering Hydrology**  
**L:T:P 3:0:0**  
**CIE: 50%**  
**Max. Marks:100**

<b>Prerequisites if any</b>	---Not required---
<b>Learning objectives</b>	1. Understanding the hydrological cycle and its processes. 2. Knowing the methods to estimate the hydrological processes.

**Course Outcomes:**

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Describe the hydrological process and estimate quantities associated with them.	Understand Apply
CO2	To Develop runoff and hydrograph estimation and apply into engineering practices.	Understand Apply
CO3	Understand Groundwater movement in aquifers.	Understand

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3					1						3		
CO3	3												1		

**Mapping Strength:** Strong- 3 Medium - 2 Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module - 1</b>				
1.1	<b>Hydrology:</b> Introduction, Importance of hydrology, Practical application of hydrology, Hydrologic cycle (Horton's) qualitative and engineering representation.	2		
1.2	<b>Precipitation:</b> Definition, Forms and types of precipitation, measurement of rain fall using Symon's and Syphon type of rain gauges,	2		
1.3	optimum number of rain gauge stations, consistency of rainfall data (double mass curve method), computation of mean rainfall,	2		
1.4	Estimation of missing data, presentation of precipitation data, moving average curve, mass curve, rainfall hyetographs.	2		
<b>Module - 2</b>				
2.1	<b>Losses: Evaporation:</b> Introduction, Process, factors affecting evaporation, measurement using IS class-A Pan, estimation using empirical formulae (Meyer's and Rohwer's equations) Reservoir evaporation and control	3		
2.2	<b>Evapo-transpiration:</b> Introduction, Consumptive use, AET, PET, Factors affecting, Measurement, Estimation by Blaney-Criddle equation,	2		
2.3	<b>Infiltration:</b> Introduction, factors affecting infiltration capacity, measurement by double ring infiltrometer, Horton's infiltration equation, infiltration indices.	3		
<b>Module - 3</b>				
3.1	<b>Streamflow and Runoff:</b> Catchment runoff. Stream flow measurement by CMG, measurement of stage. Measurement of velocity, Area velocity method.	2		
3.2	<b>Runoff:</b> Different Surface and subsurface processes, Hydrograph, Runoff characteristics of streams, Runoff volume.	2		
3.3	Rainfall-Runoff correlation, Curve number method for yield estimation.	3		
3.4	Flow duration curve, flow mass curve	1		
<b>Module - 4</b>				
4.1	<b>Hydrograph:</b> Definition, components of hydrograph, base flow separation,	2		
4.2	Unit hydrograph, assumption, application and limitations, derivation from simple storm hydrographs,	3		



4.3	S curve and its computations, Conversion of UH of different durations	3		
<b>Module – 5</b>				
5.1	<b>Groundwater Hydrology:</b> Introduction, forms of subsurface water, Saturated formation, water table	2		
5.2	Aquifer properties, Darcy's law, co-efficient of permeability	2		
5.3	Flow equations confined and unconfined, well hydraulics (introduction)	4		
<b>Total No. of Lecture Hours</b>		<b>40</b>		
			<b>Total No. of Tutorial Hours</b>	<b>--</b>
			<b>Total No. of Practical Hours</b>	<b>--</b>

**Self-learning topics identified: (Maximum of 5 topics)**

1. Characteristics of precipitation in India
2. Runoff measuring devices
3. Application of hydrograph
4. Ground water monitoring network in India

**Textbooks:**

1. Subramanya K., "Engineering Hydrology"-Tata McGraw Hill, New Delhi.- 2010.
2. H.M.Raghunath, "Hydrology" - Wiley Eastern Publication 2006.

**Reference Books:**

1. Putty M.R.Y., "Principles of Hydrology" - IK International Pub., New Delhi 2010
2. Mutreja, K.M, "Engineering Hydrology" - Mc Graw Hill, New York 2003.
3. Ven Te Chow "Handbook of applied hydrology"-, McGraw Hill Pub - 1964.

**Online Resources:**

1. <https://archive.nptel.ac.in/courses/105/103/105103213/>
2. <https://archive.nptel.ac.in/courses/105/105/105105214/>



**Code:** 21CV7E33  
**Credits:** 3  
**SEE:** 50%  
**SEE Hours:** 3

**Course: Integrated Watershed Management**  
**L:T:P 3:0:0**  
**CIE: 50%**  
**Max. Marks:100**

<b>Prerequisites if any</b>	Engineering Hydrology
<b>Learning objectives</b>	1. Understand the drainage characteristics and morphometric analysis 2. Analyze the effect of runoff and soil loss on natural resources

**Course Outcomes:**

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand the delineation of watershed from different sources and Morphometric analysis	Understand Apply
CO2	Apply the different methods to estimate the runoff and soil loss	Understand Apply
CO3	Understand the water conservation and harvesting methods	Understand

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	1				2	1						3		

**Mapping Strength:** Strong- 3 Medium - 2 Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module - 1</b>				
1.1	<b>Introduction:</b> Definition and importance, delineation of watershed, watershed characteristics,	2		
1.2	Objectives. Principles of watershed operations and management, different approaches in watershed management.	2		
1.3	Watershed management plan- identification of problems, objectives and priorities. Steps in developing watersheds.	2		
1.4	Issues in watershed management - Land degradation. Socio economic survey- collection of data, analysis of problems, watershed map.	2		
<b>Module - 2</b>				
2.1	<b>Quantitative Analysis:</b> Definition, drainage pattern - different types	1		
2.2	Horton's and Strahler's method of stream ordering	1		
2.3	Analysis - linear aspects, areal aspects, relief aspects and the inferences-Numerical	4		
2.4	Hypsometric analysis- hypsometric curve, indicators.	2		
<b>Module - 3</b>				
3.1	<b>Runoff Estimation:</b> Introduction, necessity, classification, factors affecting runoff, runoff measurement-rational method, Runoff coefficient, time of concentration	3		
3.2	Runoff characteristics, Rainfall-runoff correlation,	2		
3.3	SCS curve number, AMC-Numerical, Runoff estimation.	2		
3.4	Flood, Droughts and classification	1		
<b>Module - 4</b>				
4.1	<b>Soil loss estimation:</b> Introduction, importance, erosion processes, types of erosion, factors effecting erosion	2		
4.2	Erosion estimation, USLE, MUSLE, SYI	3		
4.3	Channel erosion	1		
4.4	Control measures and land reclamation	2		
<b>Module - 5</b>				
5.1	<b>Water Conservation and Harvesting:</b> Introduction, Types of conservation, small storage structures, types of storage structures, design data.	3		
5.2	Conjunctive water use, Water recycling, water reclamation and reuse	3		



5.3	Groundwater recharge- water harvesting methods and techniques	2		
<b>Total No. of Lecture Hours</b>		40		
		<b>Total No. of Tutorial Hours</b>		
		<b>Total No. of Practical Hours</b>		

**Self-learning topics identified: (Maximum of 5 topics)**

1. Digitization of topomaps
2. Stream flow measurement
3. Distribution of Erosion classes in India
4. Ancient water conservation methods

**Textbooks:**

1. Chatterjee, S. N.(2008) Water Resources Conservation and Management, Atlantic Publishers,
2. Murthy, V.V.N.(2004) Land and Water Management, Khalyani Publishers, 2004

**Reference Books:**

1. Muthy, J. V. S.(1998) Watershed Management, New Age International Publishers
2. Ven Te Chow(1984) Handbook of Hydrology, McGraw Hill Book Company
3. Engman, E.T and Gurney(1985) Remote Sensing in Hydrology, Apman and Hall, New York

**Online Resources:**

1. <https://archive.nptel.ac.in/courses/105/101/105101010/>



**Code:** 21CV7E34      **Course:** Analysis & Design of Water Distribution and Collection Systems  
**Credits:** 3      **L:T:P** 3:0:0  
**SEE:** 50%      **CIE:** 50%  
**SEE Hours:** 3      **Max. Marks:** 100

<b>Prerequisites if any</b>	Hydraulics and Water Supply Engineering
<b>Learning objectives</b>	1. Understanding the principles of water distribution network analysis and design with the application of software tools. 2. Getting an insight in to the hydraulic design of collection system.

**Course Outcomes:**

*On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Explain the functioning of water distribution system with different elements, various parameters and their interrelationships, formulate equations for pipe networks and analyse them using appropriate method.	Understand Apply, Analyze
CO2	Demonstrate the understanding of wastewater collection system with various appurtenances, estimate the quantity of sanitary sewage and storm water, hydraulic design of sewers.	Understand Apply
CO3	Demonstrate the usage of software tools for the analysis and design of water distribution and collection systems.	Understand, Apply, Analyze

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2									3		
CO2	3		3	2									3		
CO3	3	3	3		3				2				3	3	1

**Mapping Strength:**      **Strong– 3**      **Medium – 2**      **Low – 1**

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module – 1</b>				
1.1	Water Distribution System – Introduction, System Configuration	1	-	-
1.2	Water Demand, Pipe Systems and Piping Materials	1	-	-
1.3	Elements and Types of Water Distribution Networks	1	-	-
1.4	Reservoirs, Pumps and Pumping Stations, Valves	1	-	-
1.5	Flow Hydraulics and Network Analysis	1	-	-
1.6	Frictional Head Loss in Pipes – Empirical Formulae, Friction Coefficient Relationships, General Head Loss Formula, Simple Pipe Flow Problems on Determination of Head Loss, Discharge and Diameter	2	-	-
1.7	Head Loss in Pipes due to Minor Appurtenances	1	-	-
<b>Module – 2</b>				
2.1	Network Synthesis, Network Parameters – Pipe lengths, Pipe Diameters, Pipe Roughness Coefficients	1	-	-
2.2	Labelling Network Elements – Branched and Looped Networks, Parameter Interrelationships	1	-	-
2.3	Formulation of Equations – Single Source Networks with known Pipe Resistances	3	-	-
2.4	Solution to Equations; Hardy Cross Method – Method of Balancing Heads	3	-	-
<b>Module – 3</b>				
3.1	Collection System – Introduction, System layout	1	-	-
3.2	Types of Collection System – Separate, Combined and Partial Systems	1	-	-
3.3	Quantity of Wastewater – DWF, WWF, Sources, Factors Affecting the Quantity of Sanitary Sewage	2	-	-
3.4	Determination of Quantity of Sanitary Sewage, Peak Factor, Peak Flow	2	-	-



3.5	Determination of Quantity of Storm Water – Rational Method, Runoff Coefficient, Time of Concentration	1	-	-
3.6	Hydraulics of Sewers – Types of Flows, Hydraulic Principles	1	-	-
<b>Module – 4</b>				
4.1	Design of Sewers; Design Criteria of Sewers – Design Period, Minimum Velocity, Maximum Velocities, Self-Cleansing Velocity, Sewer Gradient	1	-	-
4.2	Materials, Shapes and Sizes of Sewers,	1	-	-
4.3	Hydraulic Formulae – Manning’s Formula, Chezy’s Formula and Hazen-Williams Formula	1	-	-
4.4	Hydraulic Elements of Sewers for Partial Flow Conditions	1	-	-
4.5	Hydraulic Design of Separate and Combined Systems	3	-	-
4.6	Sewer Appurtenances – Manhole, Drop Manholes Street Inlets, Catch Basins, Flushing Devises, Sand, Grease and Oil Traps, Sewer Outlets	2	-	-
<b>Module – 5</b>				
5.1	Introduction to EPANET and its Hydraulic Modeling Capabilities	1	-	-
5.2	Steps in using EPANET	1	-	-
5.2	Modeling/Design of Simple Water Distribution Networks using EPANET	3	-	-
5.3	Hydraulic Design of Sanitary Sewers using MS-Excel	2	-	-
<b>Total No. of Lecture Hours</b>		<b>40</b>		
			<b>Total No. of Tutorial Hours</b>	-
			<b>Total No. of Practical Hours</b>	-

**Self-learning topics identified: (Maximum of 5 topics)**

1. Operation and Maintenance of Water Distribution System
2. Special Valves, Equivalent Pipes
3. Measurement of flows in Existing Sewers
4. Sewer Transitions
5. Construction and Maintenance of Sewers

**Textbooks:**

1. Pramod Bhave, R Gupta, “Analysis of Water Distribution Networks” - Narosa Publishing House, 2009.
2. P. N. Modi, S. M. Seth, “Sewage Treatment Disposal & Wastewater Engineering” – Standard Book House, 2020.

**Reference Books and Manuals:**

1. Prabhata K. Swamee, Ashok K. Sharma “Design of Water Supply Pipe Networks” - John Wiley & Sons, 2008.
2. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, “Wastewater Engineering” – Laxmi Publications, 2016
3. EPANET User Manual



**Code:** 21CV7E41  
**Credits:** 3  
**SEE:** 50%  
**SEE Hours:** 3

**Course:** Construction Surveying  
**L:T:P** 3:0:0  
**CIE:** 50%  
**Max. Marks:**100

<b>Prerequisites if any</b>	Surveying
<b>Learning objectives</b>	1. Understand the roles of a site engineer and principles underlying surveying controls 2. Comprehend the usage of recent improved techniques for construction industry

**Course Outcomes:**

*On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Describe and follow the procedures required for setting out works	Understand
CO2	Apply horizontal and vertical control techniques for setting out operations	Apply
CO3	Summarize the importance of virtual site inspection procedures and usage of advanced technologies in construction site	Understand

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2		
CO2		3											2		
CO3	2				3								2	2	

**Mapping Strength:**      **Strong- 3**      **Medium - 2**      **Low - 1**

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module - 1</b>				
1.1	<b>Introduction</b> Construction surveying, role of surveying in civil engineering practice, typical responsibilities of a construction surveyor,	02		
1.2	Skills required, Reading maps and drawings, Equipments for construction surveying; Levels, theodolite, total station, GPS, Laser levels	02		
1.3	Horizontal control and vertical control Techniques	02		
1.4	Reference grids, base line, offsets, marking control stations, reference pillars, marking corners and lines.	02		
<b>Module - 2</b>				
2.1	<b>Setting out works</b> Setting out buildings and structures.	02		
2.2	Conventional and coordinate methods, usage of Theodolite, Total Station and GPS in setting out.	02		
2.3	Measurement and methods of setting out for various Civil Engineering structures, slopes and grades and pipe lines.	02		
2.4	Controlling and checking verticality in tall structures.	02		
<b>Module - 3</b>				
3.1	<b>Route and Tunnel surveys</b> Route surveys, alignments, procuring GTS bench marks/establishing DGPS control points.	02		
3.2	Traversing and other surveys.	01		
3.3	Tunnels, Surface and underground alignments,	02		
3.4	Transferring surface alignment through vertical shafts, transferring levels.	02		
3.5	Use of laser instruments and laser/total station guided tunnel boring machines.	01		
<b>Module - 4</b>				
4.1	<b>Site Inspection and Building Information Surveying</b> Need for site inspection, Virtual site inspection	02		
4.2	Virtual reality and virtual environments – Augmented reality in construction industry.	02		

4.3	3D scanning to track progress, automated scan-to-BIM inspection, Methods for preventing delays, Identifying future problems.	02		
4.4	Building information modelling, role of artificial intelligence in BIMs, Automated data handling process.	02		
<b>Module – 5</b>				
5.1	<b>Advanced Construction Surveying Techniques</b> Digital capture of construction data, digital image processing and recognition,	01		
5.2	Use of laser scanners for 3D modelling and designing. Point Cloud registration, visualisation and laser data analysis.	02		
5.3	Drone technology, Photogrammetry - Geometry of vertical aerial photographs- scale, ground coordinates, relief displacement, photographic overlaps, flight planning. Role of UAV's in construction projects, payloads and sensors.	03		
5.4	Application of UAV's in road, dam and building construction.	02		
<b>Total No. of Lecture Hours</b>		<b>40</b>		
<b>Total No. of Tutorial Hours</b>				
<b>Total No. of Practical Hours</b>				

**Self-learning topics identified:**

1. Use of laser level in construction
2. Data collection apps for construction surveys
3. Computer aided earth work calculations

**Textbooks:**

1. A.M. Chandra. "**Higher Surveying**" New Age International Publishers, 2007.
2. Uren, John, William Frank Price. "**Surveying for engineers**". Macmillan International Higher Education, 2010.
3. Tal, Daniel, and Jon Altschuld. "**Drone Technology in Architecture, Engineering and Construction: A Strategic Guide to Unmanned Aerial Vehicle Operation and Implementation**". John Wiley & Sons, Incorporated, 2021.

**Reference Books:**

1. James M Anderson, Edward M Mikhail., "**Introduction to Surveying**", McGraw Hill Publications, 1984.
2. S.K. Roy., "**Fundamentals of Surveying**", Prentice Hall of India New Delhi, 2009.
3. Kavanagh, Barry F., Dianne Kay Slattery., "**Surveying: with construction applications**". Upper Saddle River, NJ: Pearson, 2010.
4. Taylor, Gil L., "**Construction codes and inspection handbook**". McGraw-Hill Professional, 2006.
5. Whyte, Jennifer, and Dragana Nikolić., "**Virtual reality and the built environment**". Routledge, 2018.

**Online Resources:**

1. <https://archive.nptel.ac.in/courses/105/103/105103176/> NPTEL MOOC course on "**Introduction to Higher Surveying**", Prof. Ajay Dashora.
2. <https://archive.nptel.ac.in/courses/105/107/105107158/> NPTEL MOOC course on "**Digital Land Surveying and Mapping**", Prof. Jayanta K Ghosh, IIT Roorkee.



**Code:** 21CV7E42  
**Credits:** 3  
**SEE:** 50%  
**SEE Hours:** 3

**Course:** Geoinformatics for Civil Engineers  
**L:T:P** 3:0:0  
**CIE:** 50%  
**Max. Marks:**100

<b>Prerequisites if any</b>	Highschool Geography, Surveying
<b>Learning objectives</b>	1. Outline basic concepts of GIS and Remote sensing 2. Summarize applications of Geospatial technology in Civil Engineering

**Course Outcomes:**

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Describe concepts and components of GIS and Mapping	Understand
CO2	Understand and discuss concepts of Remote sensing, satellites and sensors	Understand
CO3	Demonstrate the use of Remote sensing, GIS, Satellite data, GPS for various applications	Understand Apply

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				2								3		
CO2	3				2								2		
CO3	2				2	2							2	2	

**Mapping Strength:** Strong– 3 Medium – 2 Low – 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module – 1</b>				
1.1	<b>Concepts Geographic Information System</b> Definition of GIS, history and evolution of GIS, GIS Technology, functions, components, tools, capabilities.	02		
1.2	Geospatial data, GIS data formats, data storage formats.	02		
1.3	GIS data acquisition, source – primary and secondary data, generation, display.	02		
<b>Module – 2</b>				
2.1	<b>Concepts of Geodesy, Maps and Transformation</b> Shape of earth, Georeferencing systems (introduction only), Continuous and discrete georeferencing.	02		
2.2	Geodetic datums, representations of earth, coordinate reference systems, GCS and PCS.	01		
2.3	Map, map layout, features of a map, Topographic map, scale of a map.	01		
2.4	Geometric transformation, map projection and types (cylindrical, cone, azimuthal),	02		
2.5	Universal Transverse Mercator (UTM) projection, projection distortion, preserving map properties.	02		
<b>Module – 3</b>				
3.1	<b>Introduction to Remote Sensing, Satellites and Sensors</b> Definition of remote sensing, remote sensing process, ideal remote sensing system.	02		
3.2	Physics of remote sensing, electromagnetic energy, electromagnetic spectrum, black body radiation, laws governing electromagnetic radiation, atmospheric effects, scattering and absorption, atmospheric windows, Interaction with earth surface materials, spectral reflectance curves.	03		
3.3	Remote sensing platforms, satellites and orbits, geostationary and sun synchronous satellites, Earth resource satellites – IRS mission, LANDSAT, other satellite missions.	02		
3.4	Sensors – active and passive sensors, sensor resolutions (spectral, spatial, radiometric and temporal).	02		
<b>Module – 4</b>				
4.1	<b>Recent Advances in Geoinformatics</b> Introduction to Global Positioning System (GPS), segments of GPS, working principle, satellite geometry, errors in GPS, differential GPS surveying,	03		
4.2	Navigation system Worldwide, applications of GPS.	02		

4.3	Introduction to UAV photogrammetry, Geometry of vertical aerial photographs- scale, ground coordinates, relief displacement, photographic overlaps, flight planning.	02		
4.4	Drones – types, payloads, limitations, software and applications of UAVs in civil engineering projects.	02		
<b>Module – 5</b>				
5.1	<b>Applications of Geoinformatics</b> Land use/cover mapping, Agriculture and forestry.	02		
5.2	Road and Bridge construction, Urban and regional planning applications - city planning, solid waste management.	02		
5.3	Applications in water resources and management, Environmental applications.	02		
5.4	Disaster management applications - Flood mapping, Pandemic hotspots analysis.	02		
<i>Total No. of Lecture Hours</i>		<b>40</b>		
<i>Total No. of Tutorial Hours</i>			--	
<i>Total No. of Practical Hours</i>				--

**Self-learning topics identified:**

1. List of open source spatial data sources
2. Common image processing and GIS software
3. List of Earth resource satellites/missions by countries.

**Textbooks:**

1. Lillesand T.M., and R.W. Kiefer, “**Remote sensing and Image interpretation**”, 4th edition, John Wiley & Sons, 2012.
2. Burrough, P. A., McDonnell, R., McDonnell, R. A., & Lloyd, C. D. “**Principles of geographical information systems**”, 3<sup>rd</sup> Edition, Oxford university press, 2015.
3. Chang, K. T. “**Introduction to geographic information systems**”, 9<sup>th</sup> Edition, Boston: McGraw-Hill Higher Education, 2019.

**Reference Books:**

1. Manoj K. Arora, R.C. Badjatia. “**Geomatics Engineering**”, Nemichand & Bros. Roorkee, 2011.
2. Panigrahi, N. “**Geographical information science**”. Universities press, 2009.
3. Reddy, M. A. “**Remote Sensing and Geographical Information Systems: An Introduction**”, 4<sup>th</sup> Edition, Book Syndicate, 2012.
4. DeMers, M. N. “**Fundamentals of geographic information systems**”, 4<sup>th</sup> Edition, John Wiley & Sons, 2008.

**Online Resources:**

1. <https://nptel.ac.in/courses/107105088> NPTEL MOOC course on “**Geographic Information System**” IIT Kharagpur, Prof. Bharath H Aithal.
2. <https://www.e-education.psu.edu/geog485/node/91>
3. Geographic Information Systems OER by NPTEL - <https://nptel.ac.in/courses/105107206>
4. Open Web Mapping OER by Penn State - <https://www.e-education.psu.edu/geog585/node/519>



Code: 21CV7E43

Course: Occupational Safety and Health for Civil Engineers

Credits: 3

L: T:P 3:0:0

SEE: 50%

CIE: 50%

SEE Hours: 3

Max. Marks:100

<b>Prerequisites if any</b>	Basic Knowledge of Identification and Implication of Hazard at Workplace
<b>Learning objectives</b>	1. Understand Occupational Health and Safety and its practice in the industry 2. Identify hazards, assess the risks and auditing methodology

**Course Outcomes:***On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Understand Occupational Health and Safety and its practice in the industry, with particular emphasis towards civil engineering.	Understand
CO2	Identify hazards, assess the risks, and manage the consequences	Apply
CO3	Role of Safety Personnel in OSH , Demonstrating a Safety Audit as per IS -14489	Analyze

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1				3					3				2		
CO2			2				2			3					1
CO3	2				1						1			3	1

Mapping Strength: Strong- 3 Medium - 2 Low - 1

**Course Structure**

		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
<b>Module – 1</b>				
1.1	<b>Introduction to Occupational Safety and Health</b> Overview of occupational safety and health (OSH) principles	01	NA	NA
1.2	Importance of OSH in civil engineering projects	01	NA	NA
1.3	Indian Factories act, 1948	01	NA	NA
1.4	OSHA regulations applicable to civil engineering	01	NA	NA
1.5	Components of SMS: policy, planning, implementation, and evaluation	01	NA	NA
1.6	Compliance requirements and penalties for non-compliance	01	NA	NA
1.7	Emergency preparedness and response	01	NA	NA
1.8	Site-specific safety plans and procedures	01	NA	NA
<b>Module – 2</b>				
2.1	<b>Hazards in Workplace, Hazard Identification Methods and Hazard Control Methodology</b> Common safety hazards in construction sites	1	NA	NA
2.2	Physical Hazard at Workplace, control hierarchy	2	NA	NA
2.3	Chemical Hazard including Radioactive Metals – Exposure- case studies	1	NA	NA
2.4	Fire Hazard – types, extinguishing agents and methods	1	NA	NA
2.5	Electrical Hazard – benefits of Earthing	1	NA	NA
2.6	Ergonomic Hazard – envelopes and mitigation	1	NA	NA
2.7	Methods for identifying hazards- What if? HAZOP, FMEA, and ISHIKAWA/Fish Bone Method	1	NA	NA
2.8	Hazard Control Hierarchy and Hazard Control Methods Types of PPE for civil engineering tasks, Proper selection, use, and maintenance of PPE	2	NA	NA
<b>Module – 3</b>				
3.1	<b>Risk Assessment Techniques</b> Importance of and need for risk management	01	NA	NA
3.2	Assessment of likelihood of occurrence of mishap and severity of consequence	02	NA	NA
3.3	Determination of risk	02	NA	NA
3.4	Bow-tie and ALARP techniques of hazard identification and risk analysis	02	NA	NA
3.4	MISHAP Tree Analysis- ETA & FTA Analysis	03	NA	NA
<b>Module – 4</b>				



4.1	<b>International safety standards and guidelines,</b> Safety Management Systems	01	NA	NA
4.2	Deming's Cycle, Risk Management Plan, Risk Management Scheme	02	NA	NA
4.3	Safety Leadership and Communication Role of leadership in promoting a safety culture - Effective communication strategies for promoting safety - Building and maintaining a safety-conscious team	02	NA	NA
4.4	Safety improvement plans for a hypothetical civil engineering project.	01	NA	NA
4.5	Case studies of effective safety management in civil engineering projects	02	NA	NA
<b>Module – 5</b>				
5.1	<b>OSH Audit Methodology</b>	01	NA	NA
5.2	IS-14489 Audit Methodology	02	NA	NA
5.3	Annexure A, B and C of IS-14489	02	NA	NA
<b>Total No. of Lecture Hours</b>		<b>42</b>		
<b>Total No. of Tutorial Hours</b>			NA	NA
<b>Total No. of Practical Hours</b>			NA	NA

**Self-learning topics identified:**

1. International and national laws, Workmen's Compensation Act
2. First aid and medical care in case of Hazard exposure
3. India Government initiatives in OSH- risk assessment
4. Safety inspection
5. Documentation and reporting of OSH Audit

**Textbooks:**

1. Industrial Safety Sectional Committee CHD 8, IS 14489: 2018, "Occupational health and safety audit - Code of practice (First Revision)", Bureau of Indian Standards.
2. Narayanaraju G. (Secretary to GOI), "The Occupational Safety, Health and Working Conditions Code, 2020", NO. 37 OF 2020, Govt. of India, Ministry of Law and Justice

**Reference Books:**

1. Deshmukh, L.M., "Industrial Safety Management", Tata McGraw Hill, 2010.
2. Krishnamurthy, N., "Introduction to Enterprise Risk Management", Partridge Publishing, 2019.
3. Mishra, R.K., "Safety Management", AITBS Publishers, 2017.
4. Rana, S.P., P.K. Goswami, and Indu Rathee, "Handbook of Occupational Safety and Industrial Psychology", S. Chand, 2014.
5. Sharma, S.C. and Vineet Kumar, "Safety, Occupational Health and Environmental Management in Construction", Khanna Publishers, 2014.
6. Ministry of Labor and Employment, "The Employees Compensation Act, 1923"

**Online Resources:**

1. Carbon Monoxide in Construction/Portable Gas-Powered Equipment. <https://www.osha.gov/>
2. Safety and Risk Analytics, IIT Kharagpur, NPTEL  
<https://youtu.be/n1xRXAkXwjE?si=U5K6M-JMRtCFpmlh>
3. Industrial Safety Engineering by Prof J Maiti, NPTEL Lecture by IIT Kharagpur  
<https://youtu.be/jFDWIKayrTc?si=Fi8mvo62AviT7lxG>



**Code:** 21CV7S01  
**Credits:** 2  
**SEE:** --  
**SEE Hours:** --

**Course: Technical Seminar**  
**L:T:P:S 0:0:0:2**  
**CIE: 50 marks**  
**Max. Marks:50**

<b>Prerequisites if any</b>	None
<b>Learning objectives</b>	Inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

**Course Outcomes:**

*On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Attain, use and develop knowledge in the field of civil engineering and other disciplines through independent learning and collaborative study to identify, understand and discuss current, real-time issues.	L2
CO2	Prepare presentation based on the collected information and show communication, interpersonal and presenting skills.	L4

**Mapping with POs and PSOs:**

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		2
CO2								3	3				2		3

**Mapping Strength: Strong- 3 Medium - 2 Low - 1**

**Course Structure**  
**List of Projects:**

1	Each student, under the guidance of a Faculty, shall choose, preferably, a recent topic of his/her interest relevant to the Course of Specialization. <ul style="list-style-type: none"> <li>Carryout literature survey, organize the seminar content in a systematic manner.</li> <li>Present the seminar topic orally and/or through power point slides.</li> <li>Answer the queries and involve in debate/discussion.</li> <li>Submit typed report with a list of references.</li> </ul>	-	-	24
<b>Total No. of Lecture Hours</b>		--		
			<b>Total No. of Tutorial Hours</b>	
			--	
			<b>Total No. of Practical Hours</b>	
			24	



# **DETAILED SYLLABUS VIII SEMESTER**



Code: 21CV8I01

Course: Research/Industry Internship

Credits: 8

L: T:P 0:0:8

SEE: 50%

CIE: 50%

SEE Hours: --

Max. Marks: 200

<b>Prerequisites if any</b>	Design of RC Structures
<b>Learning objectives</b>	<ol style="list-style-type: none"> <li>1. Understand current research in the research field.</li> <li>2. Familiarize with the field and imparts the skill required for carrying out research.</li> <li>3. Understand and apply to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures.</li> </ol>

**Course Outcomes:**

On the successful completion of the course, the student will be able to

COs	Course Outcomes	Bloom's level
CO1	Understand and acquire the workflow of the project and simultaneously learn the tools and techniques to meet with the project requirements	Apply
CO2	Understand the significance of research, inculcate the research aptitude and design experiments and procedures to meet the research objectives	Apply

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3			2			2	2	2		2	3		
CO2	2	3			3			3	2	2		2	3		

Mapping Strength: Strong- 3 Medium - 2 Low - 1

**Course Structure**

Sl. No.		No. of Lecture Hours	No. of Tutorial Hours	No. of Practical Hours
1	Research/Industrial Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes. The mandatory Research internship /Industry internship is for 24 weeks. The internship shall be considered as a head of passing and shall be considered for the award of a degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.	NA	NA	96
<b>Total No. of Lecture Hours</b>		NA		
<b>Total No. of Tutorial Hours</b>			NA	
<b>Total No. of Practical Hours</b>				96



**Code:** 21CV8P01  
**Credits:** 8  
**SEE:** 50%  
**SEE Hours:** -

**Course: Project Work**  
**L:T:P 0:0:8**  
**CIE: 50%**  
**Max. Marks:200**

<b>Prerequisites if any</b>	None
<b>Learning objectives</b>	Demonstrate a sound technical knowledge of their selected project topic.

**Course Outcomes:**

*On the successful completion of the course, the student will be able to*

COs	Course Outcomes	Bloom's level
CO1	Plan and work out an action plan in a team for completion of a civil engineering problem.	Understand Apply
CO2	Prepare documents in team and make individual presentations	Analyze

**Mapping with POs and PSOs:**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			3	3	3								3		2
CO2									3	3			2		3

**Mapping Strength:**      **Strong– 3**      **Medium – 2**      **Low – 1**

**Course Structure****List of Projects:**

1	The project is offered to the students in order to inculcate research attitude and develop corresponding skills. A group of maximum four students work as a team for major project. Major project could be in the form of experimental investigation, computational work, data collection and its analysis etc. At the end of the major project, a report will be made wherein the details of the work undertaken, methodology adopted, conclusions drawn are provided. Evaluation of the major project is done as per the rubrics.	-	-	96
<b>Total No. of Lecture Hours</b>		<b>Total No. of Tutorial Hours</b>		
		<b>Total No. of Practical Hours</b>		<b>96</b>