Bharati Vidyapeeth

(Deemed to be University)

Pune, India

College of Engineering, Pune

Program Curriculum

B.Tech (Civil Engineering)-2023

Sem – VII & VIII

(As Per NEP 2020 Guidelines)

(w.e.f. from 2026-27)

VISION OF UNIVERSITY:

Social Transformation through Dynamic Education

MISSION OF UNIVERSITY:

- To make available quality education in different areas of knowledge to the students as per their choice and inclination
- To offer education to the students in a conducive ambience created by enriched infrastructure! and academic facilities in its campuses.
- To bring education within the reach of rural, tribal and girl students by providing them substantive fee concessions and subsidized hostel and mess facilities
- To make available quality education to the students of rural, tribal and other deprived sections of the population

VISION OF THE INSTITUTE

To be World Class Institute for Social Transformation through Dynamic Education.

MISSION OF THE INSTITUTE

- To provide quality technical education with advanced equipment, qualified faculty members, infrastructure to meet needs of profession and society.
- To provide an environment conducive to innovation, creativity, research and entrepreneurial leadership.
- To practice and promote professional ethics, transparency and accountability for social community, economic and environmental conditions.

DEPARTMENT OF CIVIL ENGINEERING

VISION OF DEPARTMENT

To create Civil Engineers who will transform Civil Engineering Industry for sustainable development of society.

MISSION OF DEPARTMENT

- To create Civil Engineers enriched with quality technical education.
- To create entrepreneurs practicing professional ethics.
- To inculcate innovation, creativity and research approach among the graduants.

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE

PROGRAMME: B.TECH (CIVIL ENGINEERING)

Programme Educational Objectives (PEOs):

PEO1: To prepare students for career in Civil Engineering Profession.

PEO2: To develop a responsible 'Entrepreneur.'

PEO3: To develop the student to cope up with the advancements in Civil Engineering.

Programme Outcomes (PO): An Engineering Graduates will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion, adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering

management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Programme Specific Outcomes (PSOs): A Civil Engineering Graduates will be able to:

PSO1: Industry Exposure: adapt to work and address challenges in construction Industry.

PSO2: Optimal and Sustainable Solution: workout optimal and sustainable solution to infrastructural needs of the society

Codes & Abbreviations

Programme Code:

Commencement/ Revised Year	Faculty Code (Engg & Tech)	Programme Type (UG)	Programme Number	Programme Code
xx	xx	x	xx	xxxxxxx
23	11	2	13	2311213

Course Code:

Type of Course (Alphabets)	Commencement / Revised Year	Faculty Code	Programme Number	Exam Sem/Year	Course Number	Course Code
AA	00	00	00	0	00	**AA000000000**
MJ	23	11	13	7	01	**MJ231113701**

Abbreviation

BS	Basic Science	MJ	Major (Core) Course
MI	Minor Course	GE	General Elective Course
OE	Open Elective Course	SE	Skill Enhancement Course
AE	Ability Enhancement Course	VE	Vocational Enhancement Course
VS	Vocational Skill Course	VA	Value Added Course
CC	Co-Curricular Course	ID	Interdisciplinary Course
MD	Multi-disciplinary Course	RP	Research/Project Course
PC	Practical Course	EC	Social Activity
AC	Audit Course	BM	Basic Mathematics
BC	Basic Physics	BP	Basic Physics
EG	Engineering Graphics	ES	Engineering Science
UH	Universal Human Values	PE	Program Elective
IN	Internship		

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE

B. Tech. (Civil Engineering): (2023 COURSE)- 2311202

(w.e.f. AY 2026-27)

Module-I

Sr. No	Category	Course Code	Course	Teaching Scheme			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	PE	PE231113701	Program Elective II/III	3	-	1	60	40	25	-	-	125	3	-	1	4
2.	RP	RP231113702	Seminar	-	4	-	-	-	50	-	50	100	-	2	-	2
3.	IN	IN231113703	Internship	-	-	-	-	-	150	-	100	250	-	14	-	14
			Total	**3**	**4**	**1**	**60**	**40**	**225**	**-**	**150**	**475**	**3**	**16**	**1**	**20**

Module-II

Sr. No	Category	Course Code	Course	Teaching Scheme			Examination Scheme (Marks)						Credits			
				L	P	T	ESE	IA	TW	PR	OR	Total	L	P	T	Total
1.	MJ	MJ231113801	Earthquake Resistant Design of Structures	3	-	1	60	40	25	-	25	150	3	-	1	4
2.	MJ	MJ231113802	Foundation Engineering	3	-	1	60	40	25	-	-	125	4	-	-	4
3.	PE	PE231113803	Program Elective II/III	3	-	1	60	40	25	-	-	125	3	-	1	4
4.	RP	RP231113804	Project Work	-	16	-	-	-	100	-	50	150	-	8	-	8
			Total	**11**	**16**	**2**	**180**	**120**	**175**		**75**	**550**	**10**	**8**	**2**	**20**

Instructions

1. Students shall be permitted to opt either Module I or Module II in a semester; simultaneous enrolment in both modules shall not be allowed.
2. Student need to select Program Elective- II & Elective- III from following list of courses-

List of Program Electives – II & III

1) Advanced Construction Materials	9) Design of Fiber Reinforced Concrete Structures
2) Operation Research of Engineering Optimization	10) Real Estate Development & Management
3) Air and Noise Pollution	11) Environmental Impact & Risk Assessment
4) Geospatial Image Processing	12) Big Geospatial Data Analytics
5) Engineering Geology & Rock Mechanics	13) Soil Dynamics & Machine Foundations
6) Advanced Design of Structures	14) Pre-stressed Concrete Design
7) Airport Planning & Design	15) Analysis & Design of Bridges
8) Design of Hydraulic Structures	16) Watershed Management

Programme:
B. Tech. (Civil)-2023
Module-I

PROGRAM ELECTIVES

PROGRAM ELECTIVE: ADVANCED CONSTRUCTION MATERIALS		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Building Materials & Construction
2	Concrete Technology
3	Strength of Materials
Course Objective: On completion of the course -	
	students will be able evaluate, and select advanced construction materials based on performance, durability, and sustainability requirements.
Course Outcomes: On completion of the course, the students will be able to -	
1	analyse the properties and applications of advanced masonry and block materials used in modern building construction.
2	compare conventional and modern materials based on performance criteria.
3	analyse the properties and applications of advanced steel and composite materials used in structural strengthening and retrofitting.
4	analyse the durability and sustainability aspects of materials.
5	conduct basic material characterisation and interpret results.
6	develop project-based solutions using innovative materials.

Course Content:

Unit-I	**Advanced Masonry and Block Materials** Introduction to advanced masonry materials, Fly ash bricks, Autoclaved Aerated Concrete (AAC) blocks, Hollow concrete blocks, Interlocking masonry blocks, Glass bricks, Properties and applications of advanced masonry materials in modern building construction.	**(06 Hrs)**
Unit-II	**Sustainable & Green Construction Materials:** Supplementary Cementitious Materials (Fly ash, GGBS, Silica fume), Alkali-activated binders and low-carbon cement alternatives, Recycled aggregates and waste-based materials (plastic, rubber, industrial waste), Green concrete and carbon footprint reduction, Life Cycle Assessment (LCA) and sustainable material selection criteria.	**(06 Hrs)**
Unit-III	**Advanced Steel & Composite Materials:** High strength structural steel and corrosion-resistant steel, Weathering steel and performance characteristics, Fiber Reinforced Polymer (FRP) composites, Glass Fiber Reinforced Polymer (GFRP) and Carbon Fiber Reinforced Polymer (CFRP), Application of composites in retrofitting and strengthening of structures.	**(06 Hrs)**
Unit-IV	**Smart & Functional Construction Materials:** Self-healing concrete and bacterial concrete, Shape Memory Alloys in civil engineering, Nano-materials and nano-modification of concrete, Photocatalytic	**(06 Hrs)**

	and self-cleaning materials, Phase Change Materials (PCM) for thermal regulation, Embedded sensors and smart monitoring materials, introduction to Structural Health Monitoring (SHM) systems.	
Unit-V	**Advanced Testing & Durability Assessment:** Non-Destructive Testing (NDT) methods for concrete and steel, Rebound Hammer and Ultrasonic Pulse Velocity test, Durability tests – permeability, chloride penetration, carbonation, Corrosion assessment techniques, Microstructural analysis basics (XRD, SEM), Field quality control and material performance evaluation, Rapid Chloride Penetration Test (RCPT).	**(06 Hrs)**
Unit-VI	**Emerging Materials & Industry Applications:** 3D printing materials in construction, Lightweight concrete and aerated materials, Prefabricated and modular construction materials, High-performance insulation materials, Fire-resistant and impact-resistant materials, Case studies of innovative infrastructure projects using advanced materials.	**(06 Hrs)**

Term Work: The term work consists of following-

1	Study and demonstrate different advanced masonry materials (Fly ash bricks, AAC blocks, hollow blocks) and prepare a comparison based on properties and applications.
2	Collect samples/data of sustainable materials (Fly ash, GGBS, recycled aggregate) and analyse their environmental benefits and use in green concrete.
3	Study and present different types of advanced steel and composite materials (FRP, GFRP, CFRP) with their applications in strengthening of structures.
4	Study smart construction materials (self-healing concrete, nano-materials, PCM) and prepare a report on their working principles and applications.
5	Perform or study Non-Destructive Testing methods (Rebound Hammer/UPV) and prepare a report including procedure, observations, and results.
6	Study emerging construction technologies (3D printing, prefabrication, lightweight concrete) and present a case study of any modern project.
7	Site Visit.

Reference Books:

1	A. M. Neville, “Properties of Concrete”, Pearson Education.
2	M. S. Shetty “Concrete Technology”, S. Chand Publication, New Delhi.
3	M. L. Gambhir, “Concrete Technology”, Tata McGraw Hill Publication.
4	P. Kumar Mehta and Paulo J. M. Monteiro, “Concrete: Microstructure, Properties and Materials” , McGraw Hill Education.
5	Peter Domone and John Illston, “Construction Materials: Their Nature and Behaviour”, CRC Press / Taylor & Francis.
6	Michel S. Mamlouk and John P. Zaniewski, “Materials for Civil and Construction Engineers” , Pearson Education.
7	Neil Jackson and Ravindra K. Dhir ,“Civil Engineering Materials”, Palgrave Foundations.
8	P. K. Mallick, “Fiber-Reinforced Composites: Materials, Manufacturing and Design” , CRC Press.
9	K. K. Chawla, “Composite Materials: Science and Engineering”, Springer Publication.

PROGRAM ELECTIVE: OPERATION RESEARCH OF ENGINEERING OPTIMIZATION		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Engineering Mathematics
2	Programming Basics
Course Objective: On completion of the course -	
	the student should be able to apply optimization methods to analyze and solve engineering problems and develop efficient design solutions.
Course Outcomes: On completion of the course, the students will be able to -	
1	understand fundamentals of optimization.
2	apply unconstrained optimization techniques.
3	solve constrained optimization problems.
4	use evolutionary algorithms.
5	apply optimization to real-life problems.
6	develop optimization-based projects.

Course Content:

Unit-I	**Introduction to Engineering Design Optimization** Need for optimization in engineering design, Engineering design process and role of optimization, Classification of optimization problems, Single-variable and multi-variable design problems, Design variables, objective function, constraints, Engineering examples from mechanical, civil, electrical domains.	**(06 Hrs)**
Unit-II	**Unconstrained Optimization Techniques** Single-variable optimization: Direct methods, Multivariable optimization: Gradient-based methods, Steepest descent method, Newton and quasi-Newton method, Convergence criteria and numerical issues.	**(06 Hrs)**
Unit-III	**Constrained Optimization Methods** Equality and inequality constraints, Lagrange multiplier method, Karush–Kuhn–Tucker (KKT) conditions, Penalty function methods, Applications in structural and mechanical design.	**(06 Hrs)**
Unit-IV	**Linear and Nonlinear Programming** Linear programming problem formulation, Graphical method and simplex method, Duality and sensitivity analysis, Nonlinear programming basics, Engineering design applications.	**(06 Hrs)**
Unit-V	**Evolutionary and Metaheuristic Optimization** Limitations of classical optimization methods, Genetic Algorithms: principles and operators, Particle Swarm Optimization, Simulated Annealing, Comparison of metaheuristic technique.	**(06 Hrs)**

Unit-VI	**Multi-objective Optimization and Case Studies** Multi-objective optimization concepts, Pareto optimality and trade-off analysis, Weighted sum and Pareto methods, Case studies in engineering design optimization, Introduction to optimization software tools.	**(06 Hrs)**

Term Work: The term work consists of following- **(Any Six)**	
1	Prepare presentation/report on engineering design optimization: concepts and application.
2	Prepare presentation/report on role of optimization in modern engineering design.
3	Prepare presentation/report on unconstrained optimization techniques in engineering problems.
4	Prepare presentation/ report on constrained optimization methods and their applications.
5	Prepare presentation/report on linear programming in engineering design.
6	Prepare presentation/report on multi-objective optimization and pareto optimal solutions.
7	Prepare presentation/report on genetic algorithms for engineering design optimization.
8	Prepare presentation/report on optimization in structural engineering design.

Reference Books:	
1	S.S. Rao, “Engineering Optimization: Theory and Practice”, Wiley.
2	Kalyanmoy Deb, “Optimization for Engineering Design”, PHI.
3	Ravindran, Ragsdell & Reklaitis, “Engineering Optimization”, Wiley.
4	Singiresu S. Rao, “Applied Numerical Methods for Engineers”, Pearson.
5	Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson.

Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://nptel.ac.in/courses/112/106/112106248/
2	https://nptel.ac.in/courses/111/101/111101102/
3	https://ocw.mit.edu/courses/15-053-optimization-methods-in-management-science-spring-2013/
4	https://www.coursera.org/learn/optimization
5	https://www.udemy.com/topic/optimization/

PROGRAM ELECTIVE: AIR & NOISE POLLUTION		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Environmental Engineering
Course Objective: On completion of the course -	
	The students should be able to gain knowledge of the sources, effects, and control techniques of air pollutants and noise pollution.
Course Outcomes: The student will be able to	
1	provide general understanding of quality of air and impact on local and global effects of air pollution on humans, materials, properties and vegetation.
2	understand Scales & unit of air pollution, Air pollution episodes, Air quantity criteria and Air Quality standards, emission standards.
3	understand Meteorology, Meteorological parameters, meteorological data for atmospheric stability and air pollutant transport and dispersion.
4	discuss sampling methods & the various types of air pollution control equipment.
5	discuss Air pollution monitoring systems, Legislation and enforcement, EIA, Air pollution control Act and strategy for effective control of air pollution.
6	provide general understanding of meaning, sources& effects of noise pollution also the acts of noise pollution

Course Content:

Unit-I	**Sources and Effects of Air Pollution** Definition, sources of air pollution- Natural and Artificial, types and classification of air pollutants, Primary and Secondary air pollutants and their importance, Effects of air pollution on –Human, Animals, Materials and Vegetation. Global Effects-Photochemical smog, heat island, ozone depletion, acid rain.	**(06 Hrs)**
Unit-II	**Air Quality Assessment and Environmental Legislation** Scales of Air Pollution, Units of measurement, Quantity and composition of gaseous and particulate pollutions, Air pollution episodes, Air quantity criteria, Air Quality standards and emission standards. Introduction to - Environment (Protection) Act, 1986; Motor Vehicles Act, 1988; Air pollution control Act and strategy for effective control of air pollution. National Clean Air Programme (NCAP) and Bharat Stage-VI emission norms.	**(06 Hrs)**
Unit-III	**Meteorology and Atmospheric Dispersion of Air Pollutants** Scales of meteorology, Meteorological parameters, stability of atmosphere & Temperature lapse rate, Plume behavior, inversion phenomena, vertical stability of atmosphere, precipitation, wind patterns, direction, velocity and fluctuations, Gaussian diffusion model for finding ground level concentration, mixing heights, Determination of stack height.	**(06 Hrs)**

Unit-IV	**Air Quality Monitoring and Pollution Control Management** Air pollution monitoring and regularity control, Air Quality Monitoring Stations, Air Monitoring Instruments, Air Quality Index (AQI), Ambient Air quality standards, Preventive Measures, Air pollution control efforts, Zoning, town planning regulation of new industries, Legalization and enforcement, environmental impact assessment and air quality.	**(06 Hrs)**
Unit-V	**Noise Pollution** Sources of Noise Pollution, effects of Noise Pollution, Control of Noise Pollution, Human disease caused by noise pollution, Units and Measurements of Noise–Standard, Noise pollution Act 2000.	**(06 Hrs)**
Unit-VI	**Environmental Noise Monitoring, Assessment and Control** Noise Measurement Techniques, Noise Standards and Permissible Limits, Environmental Noise Monitoring, Noise Mapping using GIS, Traffic Noise Prediction Models, Industrial and Airport Noise, Building Acoustics, Sound Insulation Materials, Design of Noise Barriers, Urban Noise Management and Noise Impact Assessment in Environmental Impact Assessment (EIA).	**(06 Hrs)**

Term Work: The term work consists of following- **(Any Eight)**	
1	Comparative Study of Natural vs Artificial Air Pollution Sources.
2	Study of Air Quality Standards in India.
3	Compare NAAQS with WHO standards.
4	Detailed study of Environment Protection Act 1986.
5	Detailed study of Motor Vehicles Act 1988.
6	Detailed study of Air (Prevention and Control of Pollution) Act 1981.
7	Measurement of Particulate Matter (PM_{10} / $PM_{2.5}$) - Use a high-volume air sampler and Calculate concentration in $\mu g/m^3$, compare with national standards.
8	Study objectives, implementation, and effectiveness of National Clean Air Program.
9	Write assignment on Role of Meteorological Parameters in Air Pollution Dispersion.
10	Write a note on Urban Air Pollution Control Strategies - zoning, industrial regulation, and EIA.
11	Bharat Stage-VI emission norms vs previous standards.
12	Design of noise barriers for highways.
13	Measurement of Noise Levels in Different Areas by Using sound level meter - Compare noise levels in: Residential, Commercial, Industrial zones.

Reference Books:

1	C. S. Rao, “Environmental Pollution Control Engineering”, Wiley Eastern Limited.
2	Louis Theodore, Burley Intuscence “Air Pollution Control Equipment.”
3	CD Cooper and FC. Alley Wairland,“Air Pollution Control” Press III Edition.
4	Noel de Nevey, “Air Pollution Control Engineering”,– McGraw Hill.
5	M. N. Rao, H. V. N. Rao, “Air pollution”, Tata McGraw Hill Pvt Ltd, New Delhi.
6	Dr. Y. Anjaneyulu, “Air Pollution and Control Technologies”, Allied publishers Pvt. Ltd.
7	H.C Parkins, Air Pollution Mc Graw Hill Publication.
8	Wark Kenneth and Warner C.F, “Air Pollution Its Origin And Control”. Harper and Row Publishers, New York.
9	Rao C.S., “Environmental Pollution Control Engineering”, New age international Ltd, New Delhi

10	Peavy, H.S., Rowe, D.R., Tchobanoglous, G. “Environmental Engineering”, McGraw Hills, New York.
11	De Nevers, N., “Air Pollution Control Engineering”, McGraw Hill, New Delhi.
12	Martin Crawford, “Air Pollution Control Theory”, TMH Publications.
Reference Codes: Latest editions of following Codes	
1	IS 5182 – Different parts cover sampling and analysis of various air pollutants.
2	IS 11255 – Measurement of particulate matter in ambient air.
3	IS 3028 – Method for environmental noise measurement.
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://onlinecourses.nptel.ac.in/

PROGRAM ELECTIVE: GEOSPATIAL IMAGE PROCESSING		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Basic knowledge of Remote Sensing and GIS
2	Fundamentals of Digital Image Processing
3	Basic understanding of Mathematics and Statistics
4	Familiarity with computer applications and geospatial software
Course Objective: On completion of the course -	
	the students will be able to gain comprehensive knowledge and practical skills in geospatial image processing techniques from satellite and aerial imagery for real-world applications.
Course Outcomes: On completion of the course, the students will be able to -	
1	understand the basic principles and data structure of geospatial imagery.
2	apply preprocessing techniques to improve image quality and accuracy.
3	perform image enhancement for better interpretation and analysis.
4	analyze and transform geospatial images for advanced interpretation.
5	classify satellite images and evaluate classification accuracy.
6	apply geospatial image processing techniques to real-world problems.

Course Content:

Unit-I	**Fundamentals of Geospatial Image Processing:** Introduction to Remote Sensing and GIS, Electromagnetic spectrum, Types of satellite sensors, Digital image structure, Image resolution (spatial, spectral, radiometric, temporal), Image acquisition and data formats.	**(06 Hrs)**
Unit-II	**Image Pre-processing Techniques:** Radiometric correction, Atmospheric correction, Geometric correction, Image registration, Re-sampling techniques, Mosaicking and sub-setting.	**(06 Hrs)**
Unit-III	**Image Enhancement Techniques:** Contrast stretching, Histogram equalization, Spatial filtering, Edge detection, Vegetation indices (NDVI), Band ratios and composites.	**(06 Hrs)**
Unit-IV	**Image Transformation and Analysis** Principal Component Analysis (PCA), Tasseled Cap Transformation, Texture analysis, Image segmentation, Feature extraction.	**(06 Hrs)**
Unit-V	**Image Classification and Accuracy Assessment:** Supervised and unsupervised classification, Machine learning approaches, Training samples, Confusion matrix, Kappa coefficient, Accuracy assessment methods.	**(06 Hrs)**

Unit-VI	**Applications of Geospatial Image Processing Land use/land cover mapping:** Urban growth analysis, Water resource assessment, Disaster management, Change detection analysis, Integration with GIS.	**(06 Hrs)**

Term Work: The term work consists of following - **(any one from each unit)**	
1	Unit I – Fundamentals of Geospatial Image Processing ➢ Study concepts of Remote Sensing and GIS. ➢ Explain electromagnetic spectrum with diagram. ➢ Describe satellite sensors and image resolutions. ➢ Study digital image structure and data formats.
2	Unit II – Image Preprocessing Techniques ➢ Study radiometric and atmospheric correction methods. ➢ Explain geometric correction process. ➢ Describe image registration and resampling techniques. ➢ Study mosaicking and image subsetting concepts.
3	Unit III – Image Enhancement Techniques ➢ Study contrast stretching and histogram equalization. ➢ Explain spatial filtering and edge detection. ➢ Study NDVI and vegetation indices. ➢ Explain band ratios and color composites.
4	Unit IV – Image Transformation and Analysis ➢ Study Principal Component Analysis (PCA). ➢ Explain Tasseled Cap Transformation. ➢ Study texture analysis methods. ➢ Explain image segmentation and feature extraction.
5	Unit V – Image Classification and Accuracy Assessment ➢ Study supervised and unsupervised classification. ➢ Explain training samples and classification process. ➢ Prepare confusion matrix conceptually. ➢ Study accuracy assessment and Kappa coefficient.
6	Unit VI – Applications of Geospatial Image Processing ➢ Study land use/land cover mapping applications. ➢ Explain urban growth analysis. ➢ Study water resource assessment methods. ➢ Explain disaster management and change detection applications.
Reference Books:	
1	Rafael C. Gonzalez & Richard E. Woods “Digital Image Processing.”
2	Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman “Remote Sensing and Image Interpretation” Wiley.
3	John R. Jensen “Introductory Digital Image Processing” Pearson.
4	Jian Guo Liu & Philippa J. Mason “Image Processing and GIS for Remote Sensing” CRC Press.
5	B. Chanda & D.D. Majumder **“**Digital Image Processing and Analysis.**”**
Reference Codes: Latest editions of following Codes	
1	ISO 19115: Geographic information Metadata.

2	ISO 19117: Geographic information Spatial referencing by coordinates (also covers image-related aspects).
3	ISO 19123: Geographic information Schema for coverage geometry and functions.
4	ISO/TS 19130: Image sensor performance for remote sensing.
5	ISO 19128 Web Map Server (WMS) OGC standard often used with geospatial imagery.
6	ISO 19142 Web Feature Service (WFS) OGC standard.
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://arset.gsfc.nasa.gov
2	Google Earth Engine (GEE)
3	https://eobrowser.com

PROGRAM ELECTIVE: ENGINEERING GEOLOGY AND ROCK MECHANICS		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of

1	Geotechnical Engineering

Course Objective: On completion of the course -

	the students will understand minerals, rocks, and geological processes and apply rock mechanics and subsurface exploration in civil engineering projects.

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

1	understand basic geological processes and their engineering importance.
2	identify minerals and classify different types of rocks.
3	explain structural features, earthquakes, and groundwater conditions in engineering projects.
4	describe subsurface exploration methods and core drilling techniques.
5	explain engineering properties of Deccan Trap rocks.
6	apply geophysical exploration and rock mechanics concepts in engineering projects.

Course Content:

Unit-I	**Fundamentals of Engineering Geology:** The Earth-Origin, age, internal constitution. mineralogy & petrology, Geological processes such as weathering, erosion, transportation, deposition, Importance of geology in civil engineering projects, and geological hazards including landslides, rockfall and earthquakes.	**(06 Hrs)**
Unit-II	**Minerals and Rocks in Engineering:** Classification of minerals, physical properties of minerals, common rock forming and economic minerals, Classification of rocks, texture and structure of igneous, sedimentary, metamorphic rocks, petrography of common igneous, sedimentary and metamorphic rocks, engineering properties of rocks.	**(06 Hrs)**
Unit-III	**Structural Geology:** Folds, faults, joints, bedding planes, geological mapping, engineering implications of discontinuities, rock mass classification systems Seismology: An introduction to earthquake, different types of seismic waves, elastic rebound theory, global distribution of seismic zones Geohydrology -Sources of Ground water, Hydrological Zones below the surface, aquifer-confined and unconfined, engineering importance of ground water study.	**(06 Hrs)**
Unit-IV	**Site Investigation and Subsurface Exploration:** Geological investigations for projects, borehole drilling, core sampling and logging, graphical representation of core log, core recovery, Rock Quality Designation (RQD), joint frequency index, geophysical exploration methods. Introduction to geological map, GIS-based geological mapping, site selection for dam, stability of hill slopes along road and railway cuttings.	**(06 Hrs)**

Unit-V	**Engineering Geology of Deccan Traps:** Origin and characteristics of Deccan Trap formations, compact and amygdaloidal basalt, engineering properties of basalt, problems due to columnar joints, dykes, fractures, red bole layers, tachylitic basalt, volcanic breccias and fractures, Effect of jointing, hydrothermal alteration and weathering on engineering behavior, problems in tunnelling, foundation issues, seepage and tail channel erosion.	**(06 Hrs)**
Unit-VI	**Fundamentals and Applications of Rock Mechanics** Introduction to rock mechanics, physical and mechanical properties of rocks, stress–strain behaviour, rock strength parameters, rock slope stability, tunnelling, foundations on rock, underground structures, reinforcement methods such as rock bolts and shotcrete.	**(06 Hrs)**

Term Work: The term work consists of following- **(Any Six)**	
1	Role and importance of engineering geology in civil engineering projects.
2	Engineering properties of rocks and their influence on civil engineering design and construction.
3	Physical properties of minerals and their identification in the field and laboratory.
4	Case study on geophysical exploration methods for dam site selection.
5	Geological mapping techniques and their application in civil engineering projects.
6	Groundwater control techniques in excavation and foundation works.
7	Problems in tunnelling through deccan trap formations.
8	Seepage and leakage problems in dams built on deccan traps.
9	Rock reinforcement techniques: rock bolts and shotcrete.
10	Fundamentals of rock mechanics and its role in civil engineering.
Reference Books:	
1	Gupte R. B., “A Textbook of Engineering Geology”, Pune Vidyarthi Griha Prakashan, Pune.
2	Gokhale K.V.G.K. and Rao D. M., “Experiments in Engineering Geology”, TMN, New-Delhi.
3	Mukerjee P. K., “A Textbook of Geology”, The World Press Pvt. Ltd., Calcutta.
4	Dr. D.V Reddy, “Engineering Geology for Civil Engineering”, Oxfard & IBH Publishing Co. N. Delhi.
Reference Codes: Latest editions of following Codes	
1	IS 11315 (Part 1–28): Methods for laboratory determination of physical and mechanical properties of rocks.
2	IS 5878 (Part 2)- 1973: Geological investigations for tunnels.
3	IS 1892-1979:-Code of practice for subsurface investigation for foundations.
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://onlinecourses.nptel.ac.in/noc22_ce28/preview
2	https://onlinecourses.nptel.ac.in/noc22_ce90/preview

PROGRAM ELECTIVE: ADVANCED DESIGN OF STRUCTURES		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Structural Analysis
2	Design of RC Structures
Course Objective: On completion of the course -	
	the students should be able to design advanced structures in Reinforced Cement Concrete.
Course Outcomes: On completion of the course, the students will be able to -	
1	design combined footings.
2	design raft footings.
3	design pile foundation.
4	design retaining wall.
5	design flat slab.
6	design water tank.

Course Content:

Unit-I	**Design of Combined footings:** Types of combined footing, Design of slab type rectangular combined footing for two columns only. Concept of beam- slab type footing.	**(06 Hrs)**
Unit-II	**Design of Raft footings:** Types of raft foundations: Flat plate raft, Beam and slab raft, Cellular raft, Piled raft (basic concept), General layout and components, Assumptions in raft analysis, Methods of analysis, Design for bending moment & Shear, One-way shea, Punching shear, Thickness determination, Reinforcement details	**(06 Hrs)**
Unit-III	**Design of Pile Foundation:** Types of Piles, Load transfer mechanism: End nearing and skin friction resistance, negative skin friction, Determination of Pile Capacity, Structural design considerations, Design of concrete piles under axial load, Minimum reinforcement requirements, Design under uplift and lateral loads (basic concept), Concept of pile group, Group efficiency, Load distribution in pile group, Settlement of pile group (basic concept), Spacing and arrangement of piles	**(06 Hrs)**
Unit-IV	**Design of Retaining Wall:** Types of retaining wall, Design of cantilever retaining wall, Stability analysis: Sliding, Overturning, Bearing pressure, Structural design: Stem, Heel slab, Toe slab.	**(06 Hrs)**
Unit-V	**Design of Flat Slabs:** Introduction and applications of flat slabs, Components and types of flat slab, Design of flat slabs using latest I.S. Codes, Distribution of moments, Positive	**(06 Hrs)**

	moment, Negative moment, Design of slab reinforcement, Check for: Punching shear, One-way shear, Deflection.	
Unit-VI	**Design of Water Tank:** Introduction to water tanks and types, Underground tanks, Ground supported tanks, Elevated tanks (concept), Design philosophy and IS code provisions, Permissible stresses in concrete and steel for water retaining structures, Design of circular water tank, Hoop tension, Design of ring wall, Design of base slab, Crack control and serviceability requirements.	**(06 Hrs)**

Term Work: The term work consists of-	
A)	**Any THREE** design & drawings of following
1	Design combined footings.
2	Design raft footings.
3	Design pile foundation.
4	Design retaining wall.
5	Design flat slab.
6	Design water tank.
B)	**Any ONE** of following
1	Visit to ongoing construction site and prepare detailed technical report on it.
2	Case study report of any existing structure about design of above topics.
Reference Books:	
1	S. S. Bhavikatti, “Advanced R.C.C. Design”, New Age International Ltd.
2	S. Unnikrishnan Pillai, and Devidas Menon, “Reinforced Concrete Design”, Tata McGraw Hill.
3	Punmia, Jain and Jain, “Comprehensive Design of R. C. Structures”, Standard Book House.
4	Dr .H. J. Shah, “Reinforced Concrete design, Vol I and II”, Charotar Publishing house.
5	Ramamrutham, “Design of R. C. Structures”, Dhanpat Rai Publications.
6	Sinha R.C., “RCC Analysis and Design- Vol. I, II”, Chand and Co, New Delhi
Reference Codes: Latest editions of following Codes	
1	IS 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
2	IS 875-1987 (Part I to V): Code of Practice for Design Loads.
3	IS 3370: Indian Standard code of practice for concrete structures for storage of liquids, Bureau of Indian Standards, New Delhi.
4	IS 2911: Design And Construction of Pile Foundations — Code of Practice (Part 1 to 4).
	IS 1904: General requirements for design and construction of foundations in soils.
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://onlinecourses.nptel.ac.in/

PROGRAM ELECTIVE: AIRPORT PLANNING & DESIGN		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Transportation Engineering
2	Urban Planning
Course Objective: On completion of the course -	
	The students will be able to understand the principles of airport planning, design, and operations in accordance with standards prescribed by the International Civil Aviation Organization (ICAO) and the Federal Aviation Administration (FAA).
Course Outcomes: On completion of the course, the students will be able to -	
1	Describe airport components, aircraft characteristics, and site selection criteria.
2	Develop airport master plans and layouts per ICAO/FAA guidelines.
3	Design runway orientation, length, and geometric elements including corrections.
4	Design taxiways, aprons, and airside facilities with separation clearances.
5	Plan terminal buildings, visual aids, lighting, and capacity evaluation.
6	Analyse pavement design, drainage, and modern airport operations including sustainability.

Course Content:

Unit-I	**Introduction to Airport Engineering:** Airport terminology, aircraft components, classification by ICAO, and characteristics influencing design, Air traffic control aids, Factors influencing selection of land parcel for Airport and effects on bye-laws.	**(06 Hrs)**
Unit-II	**Airport Planning:** Airport Capacity & Planning, Master planning process as per FAA/ICAO, regional planning, traffic forecasting, and layout components, Zoning laws and socio-economic factors, Future Trends in Airport Planning.	**(06 Hrs)**
Unit-III	**Runway Design:** Runway orientation using wind rose diagrams, basic length calculation with corrections for elevation, temperature, and gradient, Geometric design, cross-section, and airport drainage systems.	**(06 Hrs)**
Unit-IV	**Taxiways & Aprons:** Geometric standards for taxiways, exit designs, fillet radii, and separation clearances, holding aprons, loading aprons, and optimal taxiway locations.	**(06 Hrs)**
Unit-V	**Terminal & Airside Facilities:** Focuses on terminal building functions, passenger gates, circulation, MEP systems, and visual aids like markings and signage. ATC tower, navigational aids, and runway lighting (VASI, PAPI).	**(06 Hrs)**
Unit-VI	**Pavements, Capacity & Operations:**	**(06 Hrs)**

	Flexible/rigid pavement design, construction, maintenance, and rehabilitation. Analysis of runway capacity, delays, ground access, heliports, security, and environmental planning.	

Term Work The term work consists of following- **(Any Six)**	
1	Assignment on Airport Components & Aircraft Characteristics.
2	Case Study on Airport Site Selection & Planning.
3	Comparative Study of ICAO and FAA Standards.
4	Airport Layout Drawing (CAD-Based).
5	Airport Safety & Risk Assessment Study.
6	Case Study of any International Airport.
7	Field Visit Report.
Reference Books:	
1	Khanna, S.K., Arora, M.G. and Jain, S.S., Airport Planning and Design, Nem Chand Bros., Roorkee, 2009.
2	Horonjeff, R., McKelvey, F.X., Sproule, W.J. and Young, S., Planning and Design of Airports, 5th Ed., McGraw Hill, 2010.
3	Saxena, S.C., Airport Engineering: Planning and Design, CBS Publishers.
4	Ashford, N., Stanton, H.P.M., Moore, C.A., Coutu, R., Airport Operations, 3rd Ed., McGraw Hill.
5	Wells, A.T. and Young, S.B., Airport Planning and Management, 5th Ed., McGraw Hill, 2008.
6	Bindra, S.P., Airport Engineering, Dhanpat Rai Publications.
7	Rangwala, S. C., Airport Engineering, 17th Edition, Charotar Publishing House Pvt. Ltd., Anand, India, 2019.
Reference Codes: Latest editions of following Codes	
1	ICAO Annex 14 – Aerodromes (Volume I: Aerodrome Design and Operations)
2	ICAO Aerodrome Design Manual (Doc 9157)
3	ICAO Airport Planning Manual (Doc 9184)
4	ICAO Annex 10 – Aeronautical Telecommunications
5	FAA AC 150/5300-13 – Airport Design
6	FAA AC 150/5325-4 – Runway Length Requirements
7	FAA AC 150/5320-6 – Airport Pavement Design and Evaluation
8	FAA AC 150/5360-13 – Airport Terminal Planning
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://onlinecourses.nptel.ac.in/noc26_ae01/preview
2	https://digitalskills.iitmpravartak.org.in/course_details.php?courseID=183&cart=
3	https://www.youtube.com/watch?v=LN12UXZld7k

PROGRAM ELECTIVE: DESIGN OF HYDRAULIC STRUCTURES		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Water Resources Engineering, Hydrology &Irrigation Engineering
2	Fluid Mechanics
Course Objective: On completion of the course -	
	the student should be able to understand the principles of planning and design of hydraulic structures.
Course Outcomes: On completion of the course, the students will be able to -	
1	calculate forces acting on hydraulic structures.
2	design a gravity dam.
3	design an earthen dam.
4	design ogee spillway.
5	design weirs and barrages.
6	design cross drainage works.

Course Content:

Unit-I	**Introduction to Hydraulic Structures:** Classification and functions of hydraulic structures, Site selection considerations, Forces acting on hydraulic structures, Stability analysis: sliding, overturning, bearing pressure, Uplift pressure and seepage analysis.	**(06 Hrs)**
Unit-II	**Design of Gravity Dams:** Types of dams, Elementary profile of gravity dam, Stability analysis of gravity dam, Low and high gravity dams, Introduction to arch and buttress dams, Construction materials and methods.	**(06 Hrs)**
Unit-III	**Design of Earthen Dams:** Components of an Earthen Dam, Types of Earthen Dams, Design Considerations, Design Steps of Earthen Dam, Fixation of Dam Height, Top Width, Side Slopes, Seepage Control, Stability Analysis, Upstream Protection, Failure Modes of Earthen Dam.	**(06 Hrs)**
Unit-IV	**Spillways and Energy Dissipation Structures:** Types of spillways, Ogee spillway design principles, Energy dissipation devices: stilling basin, flip bucket, Hydraulic jump and its application, Design considerations for spillways.	**(06 Hrs)**
Unit-V	**Weirs and Barrages:** Types of weirs and barrages, Hydraulic design of weirs on permeable foundations, Bligh's theory and Khosla's theory, Uplift pressure and exit gradient, Design of floor length and thickness.	**(06 Hrs)**

Unit-VI	**Canal Regulation and Cross Drainage Works:** Canal head regulator, Cross regulator and falls, Types of cross drainage works (aqueduct, siphon aqueduct, super passage, level crossing), Design considerations of canal structures, Introduction to river training works.	**(06 Hrs)**

Term work: The term work consists of following-	
	A) The term work shall consist of minimum **any TWO** projects based on following topics,
1	Design of Gravity Dam (Elementary Profile).
2	Design of Earthen Dam (Section with seepage control).
3	Design of Ogee Spillway.
4	Design of Weir on Permeable Foundation.
5	Design of Canal Fall / Head Regulator.
	B) Field visit and its report.
Reference Books:	
1	K.K. Sharma & A. Sharma, "Irrigation Engineering and Hydraulic Structures", S. Chand Publications
2	S.K. Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publications
3	P.N. Modi, "Irrigation, Water Resources and Waterpower Engineering", Standard Book House
4	Dr.R.P. Rethaliya," Design of Hydraulic Structures", Atul Prakashan
5	Dina Nath Keshri, "Analysis and Design of Hydraulic Structures", JBC Press"
6	Ghosh Karuna Moy, "Analysis and Design Practice of Hydraulic Concrete Structures", Prentice Hall India Learning Private Limited
Reference Codes: Latest editions of following Codes	
1	IS 6512 -1984: Design of Solid Gravity Dams.
2	IS 12169-1987: Criteria for Design of Small Embankment Dams.
3	IS 6938-1973: Hydraulic Design of Stilling Basins and Energy Dissipators.
4	IS 7365-1985: Design of Flip Bucket Type Energy Dissipators.
5	IS 6966 (Part I & II):1973: Hydraulic Design of Barrages and Weirs.
6	IS 7112-1973: Design of Cross Drainage Works.
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://www.hec.usace.army.mil/software/hec-ras/
2	https://nptel.ac.in/

COURSE: SEMINAR		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical: 04Hrs / Week	Term Work : 50 Marks Oral Examination : 50 Marks	Practical : 02
	Total : 100 Marks	Total : 02

Course Pre-requisites: The students should have knowledge of	
1	Core Civil Engineering Courses
2	Analytical skills
3	Soft and Computing Skill
Course Objective: On completion of the course -	
	to enable students to identify a Civil Engineering problem and develop a structured, feasible project proposal with proper planning and methodology.
Course Outcomes: On completion of the course, the students will be able to -	
1	conduct structured literature review using reputed databases.
2	identify research gaps and define problem statements.
3	develop analytical, experimental, or simulation-based methodologies.
4	apply project management tools for planning and scheduling.
5	prepare budget estimation and resource planning.
6	present technical proposals effectively.

Course Content:

Unit-I	**Problem Identification & Literature Review:** Identification of thrust areas in Civil Engineering, Research gap analysis, Review of journal papers (minimum 10–15 from Scopus/SCI/UGC Care), Use of reference management tools (Mendeley/Zotero), Preparation of annotated bibliography.	**(08 Hrs)**
Unit-II	**Problem Formulation & Objective Setting:** Framing of problem statement, Formulation of SMART objectives, Hypothesis development (if applicable), Scope, limitations, and constraints, Feasibility study (technical, financial, time).	**(08 Hrs)**
Unit-III	**Research Methodology & Tools:** Selection of methodology (Experimental / Analytical / Modelling / Simulation), Identification of tools/software, Data collection techniques (Primary/Secondary), Sampling techniques, Validation methods.	**(08 Hrs)**
Unit-IV	**Project Planning & Risk Analysis:** Preparation of Gantt Chart (MS Project/Excel), Milestone planning, Risk identification and mitigation strategy, Ethical considerations, and safety aspects.	**(08 Hrs)**
Unit-V	**Cost Estimation & Resource Planning:** Identification of manpower, material, equipment, Cost estimation techniques, Budget preparation, Funding opportunities (if applicable).	**(08 Hrs)**

Unit-VI	**Innovation, Sustainability & SDG Mapping:** Novelty identification, Sustainable engineering practices, Environmental and social impact assessment, Mapping with Sustainable Development Goals (SDGs).	**(08 Hrs)**
Term work:		
	The seminar shall consist of any project pertaining to Civil Engineering field or Interdisciplinary field. The students should submit and seminar Report. (Maximum Five Students per Project Group)	
Oral Examination:		
	The oral examination will be based on above term work and presentation with reference to course content.	

COURSE: INTERNSHIP		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Internship: Full Semester (14 ~ 16 weeks)	Term work : 150 Marks Oral : 100 Marks	Practical : 14
	Total : 250 Marks	Total : 14

Course Pre-requisites: The students should have knowledge of

1	Core Civil Engineering Courses
2	Analytical skills
3	Soft and Computing Skill

Course Objective: On completion of the course -

	The student shall be able to work effectively on civil engineering project.

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

1	understand the working environment of civil engineering projects and organizations**.**
2	apply theoretical knowledge to practical engineering problems**.**
3	develop technical, managerial, and communication skills required in professional practice.
4	understand construction planning, scheduling, and resource management**.**
5	follow safety practices, quality control procedures, and ethical responsibilities**.**
6	prepare technical reports and present project work effectively**.**

Course Content:

Internship: A student has to undergo an internship for one full semester (minimum 16 weeks) in industry / construction site / design office in Civil Engineering fields. The internship may consist of any one or more of the following:

1. Working on construction sites involving activities such as site supervision, construction methods, material testing, quality control, and safety practices related to Civil Engineering works.
2. Working in engineering planning or design offices involving preparation of drawings, design calculations, estimation, quantity surveying, and use of engineering software.
3. Working in civil engineering industries or infrastructure projects related to highways, buildings, bridges, water resources, or urban development.
4. Working in government organizations or consultancy firms such as PWD, Municipal Corporations, Irrigation Departments, or Project Management Consultancies.
5. Working in research organizations or laboratories involved in testing of construction materials, structural analysis, or development of innovative construction technologies.
6. Inhouse internship offered by the civil engineering department.

Term-work: The student shall maintain a daily work report in a logbook including activities performed, observations, and learning outcomes, duly certified by the officer in charge / industry supervisor. The student should remain in regular contact with the project guide from the institute and provide periodic updates during the internship. After completion of the internship, the student shall submit the certified internship completion certificate, logbook, and internship report of completion of the training. Students are permitted to complete their internship in a maximum of two companies.

Oral:

The oral examination will be based on above term work and internship experience.

Programme:
B. Tech. (Civil)-2023
Module- II

COURSE: EARTHQUAKE RESISTANT DESIGN OF STRUCTURES		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks Oral : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 150 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of

1	Detailing of Reinforced Concrete Structures
2	Design of Steel Structures

Course Objective: On completion of the course -

	The students will be able to design the building super structures to resist earthquake forces.

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

1	apply seismic zones factors for earthquake resistant design.
2	predict nature of vibration of structure.
3	estimate seismic forces on structure using equivalent static method.
4	estimate seismic forces on structure using dynamic method.
5	design shear wall for seismic forces.
6	detailing of reinforcement for ductile performance of structure.

Course Content:

Unit-I	**Earthquake and its Effects:** Causes of Earthquakes, Plate Tectonic, Measurements of Earthquakes, Seismic Zoning, Effects of earthquakes, Earthquakes resistant design philosophy.	**(06 Hrs)**
Unit-II	**Theory of Vibrations:** Vibrations - definition, terminologies, (SDOF) - Free, Forced, Damped, Un-damped vibrations with basic examples. Introduction to Multi-degrees of Freedom systems (MDOF), Different types of irregularities in structures.	**(06 Hrs)**
Unit-III	**Determination of Earthquake Forces-Static Method:** Basic definitions, Concept of OMRF &SMRF frames, Seismic coefficient method as per I.S. 1893, Determination of base shear, Lateral force, Storey shear diagram, Application to cantilevers.	**(06 Hrs)**
Unit-IV	**Determination of Earthquake Forces- Dynamic Method:** Dynamic Methods, Modes of Vibration, Response Spectra Method as per I.S. 1893, Choice of Method.	**(06 Hrs)**
Unit-V	**Design of Shear Wall:** Types and Concept of Shear Wall in earthquake resistance, Design of Shear wall as per 13920.	**(06 Hrs)**
Unit-VI	**Ductile Detailing of Earthquake Resistant Design:** General Provisions and rules to be followed for buildings in seismic areas, Ductile detailing of beams, columns, joints and footing for earthquake resistant design as per IS 13920.	**(06 Hrs)**

Term Work: The term work consists of following- **(Any Four)**	
1	Report on a major historical earthquake (e.g., Bhuj or Latur). Identify the tectonic causes, recorded magnitude/intensity, and categorize its impact based on the current Seismic Zoning map of India.
2	Analytical or software-based study to calculate the natural period and frequency of a Single Degree of Freedom (SDOF) system. Compare the response of damped vs. undamped vibrations using a simple water tank or cantilever model.
3	Manual calculation and software verification of Base Shear and its vertical distribution (Storey Shear) for a multi-storey building using the Equivalent Static Method as per IS 1893:2016. Plot the Storey Shear diagram.
4	Determination of lateral forces using the Response Spectrum Method. This includes calculating the first three modes of vibration, modal mass, and modal participation factors for a simple frame.
5	Structural design of a rectangular Shear Wall for a given building plan. Focus on calculating the required reinforcement to resist seismic loads and detailing it according to IS 13920.
6	Preparation of structural drawings showing ductile detailing for a typical Beam-Column joint. The sheets must strictly follow IS 13920 provisions for hoop spacing, development length, and confinement reinforcement.
Reference Books:	
1	B.N.Duggal, "Earthquake Resistance Design of Structure", Oxford University Press.
2	Pankaj Agarwal, Manish Shrikhande, "Earthquake Resistant Design of Structures" PHI Learning Pvt Ltd.
3	Dr. Vinod Hosur "Earthquake Resistant Design of Building Structures"- Wiley India.
4	National Information Centre of Earthquake Engineering, "IITK-BMTPC Earthquake Tips", NICEE Publication.
5	Anil K Gupta, "Dynamics of Structure", Prentice Hall.
6	N.Subramanian, "Design of Steel Structures", Oxford University Press.
7	Mario Paz, "Dynamics of structure", CBSPD Publication.
Reference Codes: Latest editions of following Codes	
1	IS1893: "Criteria for Earthquake Resistant Design of Structures", Bureau of Indian Standards.
2	IS13920: "Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces" Bureau of Indian Standards.
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://onlinecourses.nptel.ac.in/
2	https://www.nicee.org/

COURSE: FOUNDATION ENGINEERING		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Engineering Mechanics
2	Geotechnical Engineering
3	Mechanics of Fluids
Course Objective: On completion of the course -	
	Students will be able to investigate subsurface conditions and design suitable shallow and deep foundations.
Course Outcomes: On completion of the course, the students will be able to -	
1	describe methods of subsurface exploration and sampling techniques.
2	evaluate the bearing capacity of shallow foundations using appropriate bearing capacity theories
3	explain the concepts of settlement and consolidation in soils.
4	decide the capacity of a pile and pile group.
5	apply design principles for combined footings and suitable foundations on black cotton soils considering swelling behavior
6	understand the design principles of sheet piles and the selection criteria of suitable geosynthetics based on soil conditions.

Course Content:

Unit-I	**Site Investigation and Subsurface Exploration** Objectives and importance of site investigation, Planning of subsurface exploration programme, Methods of subsurface investigation: trial pits and borings, Soil and rock sampling: disturbed and undisturbed samples, Types of samplers, Geophysical methods of exploration: seismic refraction and electrical resistivity methods, Field tests: Standard Penetration Test (SPT), N-value corrections and significance, Digital borehole logging and GIS-based soil data management, Contents and format of a soil investigation report.	**(06 Hrs)**
Unit-II	**Bearing Capacity of Soils** Introduction, significant depth, design, modes of shear failures. Detail study of bearing capacity theories (Terzaghi, Meyerhoff, Skempton etc), factors influencing bearing capacity:- effect of water table on bearing capacity, effect of eccentricity, bearing capacity of layered soil, plate load test, Introduction to numerical modeling tools (PLAXIS / GeoStudio).	**(06 Hrs)**
Unit-III	**Consolidation of soils** Introduction, causes of settlement, pressure bulb, contact pressure, significant depth of foundation, differential settlement - I.S. criteria, components of settlement, Consolidation, 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.	**(06 Hrs)**

Unit-IV	**Pile foundation** Introduction, Classification, Pile Driving, Load Carrying Capacity of Piles, Single Pile Capacity, Dynamic Formulae, Static Formulae, pile load test and cyclic pile load test, group action: field rule, rigid block method, Negative skin Friction, Introduction to pile design software tools.	**(06 Hrs)**
Unit-V	**Shallow Foundation & Foundation on Black Cotton Soils** **Shallow Foundation**: types and applications, Principles of design of footing, steps involved in proportioning of footing, proportioning of combined footing rectangular and trapezoidal footing, raft foundation- types. **Foundation on Black Cotton Soils:** characteristics of black cotton soil, swelling potential and its evaluation methods, engineering problems, swelling pressure measurement, foundations on black cotton soil: design principles, construction techniques, under reamed piles: design principles and its construction techniques, Case studies of foundation failures.	**(06 Hrs)**
Unit-VI	**Well Foundation & Introduction of Geo-synthetics** **Well Foundation:** -Introduction, Components of well foundation, Sinking of well foundation, shifts and tilts, Remedial measures for rectification of tilts and shift. **Geo-synthetics:** Introduction, Types, Properties, Functions, Functional Requirements. Reinforced Soil-Mechanism, Reinforcement concept, Applications of geosynthetics in modern infrastructure.	**(06 Hrs)**

Term Work: The term work consists of following- **(Any Six)**	
1	Case Study on Standard Penetration Test (SPT) and Borehole Log Interpretation.
2	Comparative Study of Subsurface Exploration Methods.
3	Comparative Analysis of Bearing Capacity Theories: Terzaghi, Meyerhof, and Skempton.
4	Terzaghi's One-Dimensional Consolidation Theory: Assumptions, Derivation, and Engineering Applications.
5	Proportioning and Design of Combined Footing.
6	Proportioning and Design of Raft Foundation.
7	Case Study on the Application of Geosynthetics in Infrastructure Development.
8	Study of Types of Well Foundations and Their Design Considerations.
Reference Books:	
1	B. C. Punmia, "Soil Mechanics and Foundation Engineering", Laxmi Publications, New Delhi.
2	P. C. Varghese, "Foundation Engineering", PHI Learning Pvt. Ltd.
3	A. K. Arora, "Soil Mechanics and Foundation Engineering", Standard Publishers.
4	Gopal Ranjan, "Basic and Applied Soil Mechanics", New Age International Publishers.
Reference Codes: Latest editions of following Codes	
1	IS 1892: Code of practice for subsurface investigation for foundations.
2	IS 2131: Method for Standard Penetration Test (SPT).
3	IS 6403: Determination of bearing capacity of shallow foundations.
4	IS 2911 (Part 1 to 4): Design and construction of pile foundations.
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://nptel.ac.in/courses/105105176
2	https://onlinecourses.nptel.ac.in/noc21_ce39/preview

PROGRAM ELECTIVES

PROGRAM ELECTIVE: DESIGN OF FIBER REINFORCED CONCRETE STRUCTURES		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Structural Analysis
2	Concrete Technology
3	Design of RC Structures
Course Objective: On completion of the course -	
	the students should be able to understand, analyze, and design reinforced concrete structural members strengthened using externally bonded Fiber Reinforced Polymer (FRP) systems.
Course Outcomes: On completion of the course, the students will be able to -	
1	understand the fundamentals of fiber reinforced polymer (FRP) materials used for external strengthening of concrete structures.
2	identify the mechanical and durability properties of FRP composites and bonding materials.
3	analyze the behavior of reinforced concrete members strengthened with externally bonded FRP systems.
4	apply design guidelines and standards for flexural and shear strengthening of structural members.
5	design FRP wrapping systems for beams, slabs, and columns for improved structural performance.
6	evaluate construction techniques, installation procedures, and practical applications of FRP strengthening in existing structures.

Course Content:

Unit-I	**Introduction to Fiber Reinforced Polymer (FRP) Systems:** Introduction to FRP composites, Types of fibers used in FRP: carbon, glass, aramid, basalt, Types of FRP products: sheets, plates, laminates, wraps, Advantages and limitations of FRP strengthening, Comparison with conventional strengthening techniques, Applications of externally bonded FRP in structures.	**(06 Hrs)**
Unit-II	**Materials and Mechanical Properties:** Mechanical properties of fibers and polymer matrices, Properties of FRP composites, Adhesives and bonding agents used for external wrapping, Stress–strain behavior of FRP materials, Durability and environmental effects on FRP systems.	**(06 Hrs)**
Unit-III	**Behavior of RC Members Strengthened with FRP:** Strengthening mechanisms using externally bonded FRP, Flexural strengthening of beams, Shear strengthening of beams, Confinement of concrete columns using FRP wraps, Failure modes in FRP-strengthened members.	**(06 Hrs)**
Unit-IV	**Design Principles and Guidelines:** Design philosophy for externally wrapped FRP systems, Design	**(06 Hrs)**

	recommendations from international codes and guidelines, Design for flexural strengthening, Design for shear strengthening, Design for confinement of columns.	
Unit-V	**Analysis and Detailing of FRP Strengthened Members:** Analytical models for strengthened RC members, Bond behavior between FRP and concrete, Debonding and anchorage issues, Detailing requirements for FRP wraps, Strengthening of slabs, beams, and columns.	**(06 Hrs)**
Unit-VI	**Construction Techniques and Case Studies:** Surface preparation and installation procedures, Application methods of FRP sheets and laminates, Quality control during installation, Inspection and maintenance of FRP strengthened structures, Case studies of retrofitted structures using external FRP wrapping.	**(06 Hrs)**

Term Work: The term work consists of following-

1	Flexural Strengthening of RC Beams Using FRP: Design Numerical.
2	Shear Strengthening of RC Beams: Design Numerical.
3	Confinement of Concrete Columns Using FRP: Design Numerical.
4	Comparison of international guidelines such as American Concrete Institute (ACI 440), International Federation for Structural Concrete guidelines, ISIS Canada Manuals, etc.
5	Bond Behavior and Detailing of FRP Systems: Debonding issues and failure modes-Case Studies.
6	Construction Techniques and Case Studies: Case studies of FRP retrofitting in structures (bridges/buildings).

Reference Books:

1	Hota V. S. GangaRao, Narendra Taly and P. V. Vijay, “Reinforced Concrete Design with FRP Composites”, CRC Press.
2	Hayder A. Rasheed, “Strengthening Design of Reinforced Concrete with FRP”, CRC Press
3	Perumalsamy Balaguru, Antonio Nanni, and James Giancaspro, “FRP Composites for Reinforced and Prestressed Concrete Structures”, CRC Press.
4	Hwai-Chung Wu and Christopher D. Eamon, “Strengthening of Concrete Structures Using Fiber Reinforced Polymers (FRP)”, Woodhead Publishing.
5	Riadh Al-Mahaidi and Robin Kalfat, “Rehabilitation of Concrete Structures with Fiber-Reinforced Polymer”, Elsevier.
6	Jiping Bai, “Advanced Fiber-Reinforced Polymer Composites for Structural Applications Edited”, Woodhead Publishing.

Reference Codes: Latest editions of following Codes

1	ACI 440.2R: Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures.
2	ACI CODE-440.13-24 : Strengthening Structural Concrete with Fiber-Reinforced Polymer (FRP) Systems Code Requirements and Commentary.
3	ACI 562: Code Requirements for Assessment, Repair and Rehabilitation of Existing Concrete Structures.
4	fib Bulletin 14: Externally Bonded FRP Reinforcement for RC Structures.
5	fib Bulletin 90: Externally Bonded FRP Reinforcement for Concrete Structures (Design and Application).

PROGRAM ELECTIVE: REAL ESTATE DEVELOPMENT AND MANAGEMENT		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Basics of Construction Management
2	Principles of Engineering Economics
3	Fundamentals of Urban Planning and Building Construction
Course Objective: On completion of the course -	
	to provide fundamental knowledge of real estate development, planning, finance, legal regulations, marketing, and management of real estate projects.
Course Outcomes: On completion of the course, the students will be able to -	
1	explain the concepts and structure of the real estate sector.
2	analyze land markets and urban development policies.
3	understand legal documentation and regulatory framework in real estate.
4	evaluate financial feasibility and investment in real estate projects.
5	apply marketing and property management strategies.
6	analyze modern trends in sustainable and smart real estate development.

Course Content:

Unit-I	**Introduction to Real Estate Development** Concept and importance of real estate development, Role of real estate in economic development, Types of real estate (residential, commercial, industrial, institutional), Real estate market structure, Stakeholders in real estate development, Real estate development process and lifecycle.	**(06 Hrs)**
Unit-II	**Real Estate Planning and Project Feasibility** Site selection and land acquisition, Land use planning and zoning regulations, Feasibility analysis of real estate projects, Market analysis and demand forecasting, financial feasibility and risk analysis in real estate development. concept of land as an economic resource, land readjustment and redevelopment.	**(06 Hrs)**
Unit-III	**Legal and Regulatory Framework in Real Estate** Property ownership and transfer laws, Land documentation and registration process, Legal agreements: sale agreement, lease agreement, development agreement, Overview and objectives of RERA Act, Environmental regulations and building approvals, Government policies related to real estate development.	**(06 Hrs)**
Unit-IV	**Real Estate Finance and Investment Analysis** Sources of real estate finance including banks, financial institutions, private equity, venture capital and Real Estate Investment Trusts (REITs).	**(06 Hrs)**

	Mortgage financing and housing loans, role of housing finance companies in the development of the housing sector. Risk analysis in real estate investment including market risk, financial risk and regulatory risk.	
Unit-V	**Real Estate Marketing and Property Management** Concepts of real estate marketing, Market analysis and pricing strategies, Promotion methods: advertising, branding, digital marketing, Customer relationship management in real estate, Property and facility management of buildings.	**(06 Hrs)**
Unit-VI	**Sustainable and Smart Real Estate Development** Concept of sustainable development in real estate, Green buildings and energy efficient construction, Water conservation and eco-friendly practices, Smart cities and urban infrastructure development, Use of modern technologies such as BIM, GIS and PropTech.	**(06 Hrs)**

Term Work: The term work consists of following- **(Any Six)**	
1	Case Study on Real Estate Development Process of a Residential Project.
2	Live Project on Site Selection and Feasibility Analysis of a Real Estate Project.
3	Case Study on RERA Implementation in Maharashtra Real Estate Projects.
4	Mini Project on Land Acquisition and Property Documentation Process.
5	Live Project on Real Estate Investment and Financing Methods.
6	Mini Project on Marketing Strategies of a Real Estate Company.
7	Case Study on Property and Facility Management of Commercial Buildings.
8	Case Study on Smart City Development (e.g., Pune Smart City).
9	Mini Project on Green Building Practices in Real Estate.
Reference Books:	
1	Mike E. Miles, “Real Estate Development: Principles and Process.”
2	Real Estate Market Analysis, “Methods and Applications” , John M. Clapp.
3	Parthasarathi Banerjee, “Housing Policy in India.”
4	Peter Hall, “Urban and Regional Planning.”
5	William B. Brueggeman, “Real Estate Finance and Investments.”
6	Denise DiPasquale, “Urban Economics and Real Estate Markets.”
7	John Ratcliffe, “Urban Planning and Real Estate Development.”
8	David Isaac, “Property Valuation Principles.”
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://nptel.ac.in
2	https://nptel.ac.in
3	https://ocw.mit.edu
5	https://rera.gov.in

PROGRAM ELECTIVE: ENVIRONMENTAL IMPACT AND RISK ASSESSMENT		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1.	Basic knowledge of Environmental Engineering
2.	Understanding of Ecology and Environmental Pollution
3.	Fundamentals of Air, Water and Noise Pollution
4.	Basic concepts of Environmental legislation and sustainability
Course Objective: On completion of the course -	
	the students should be able to acquire fundamental knowledge of Environmental Impact Assessment, impact analysis, and risk assessment for sustainable engineering development.
Course Outcomes: The student will be able to,	
1	expound the concept, objectives and regulatory framework of Environmental Impact Assessment (EIA).
2	describe the EIA process and apply different impact identification and evaluation methods.
3	analyse environmental impacts on air, water, land, noise and socio-economic environment.
4	develop Environmental Management Plans and suggest mitigation and monitoring measures.
5	assess environmental risks using qualitative and quantitative risk assessment methods.
6	apply environmental risk management principles and regulatory compliance procedures.

Course Content:

Unit-I	**Introduction to Environmental Impact Assessment (EIA):** Concept and importance of Environmental Impact Assessment, Objectives and principles of EIA, Environmental components: Physical, Biological and Socio-economic environment, Environmental impacts: Types (Direct, Indirect, Cumulative, Short-term, Long-term), Evolution of EIA globally and in India, Overview of EIA Notification and regulatory framework in India.	**(06 Hrs)**
Unit-II	**EIA Process and Methodologies:** Steps in Environmental Impact Assessment process, Screening and Scoping, Baseline environmental studies, Impact identification and prediction, Environmental impact evaluation methods - Checklist methods, Matrix methods (Leopold Matrix), Network method, Overlay mapping technique.	**(06 Hrs)**
Unit-III	**Environmental Impact Analysis and Prediction:** Prediction of impacts on: Air environment, Water environment, Land and soil environment, Noise environment. Ecological impact assessment, Socio-economic impact assessment, Environmental indicators and indices, Use of models in environmental impact prediction. Practical Case Studies from Indian Infrastructure Projects.	**(06 Hrs)**

Unit-IV	**Environmental Management Plan (EMP) and Mitigation Measures:** Concept and components of Environmental Management Plan, Impact mitigation strategies, Environmental monitoring programs, Environmental audit, Environmental management systems (EMS), Role of sustainable development in EIA.	**(06 Hrs)**
Unit-V	**Environmental Risk Assessment:** Concept of risk, hazard and vulnerability, Types of environmental risks, Risk assessment framework, Qualitative vs Quantitative Risk Assessment, Risk probability and consequence analysis, Environmental health risk assessment, Acceptable risk levels and regulatory standards.	**(06 Hrs)**
Unit-VI	**Risk Management:** Environmental risk management framework, Environmental legislation related to risk management, Role of regulatory agencies, Environmental compliance and monitoring, Environmental clearance process, Environmental Impact Statement (EIS), Environmental safety regulations	**(06 Hrs)**

Term Work: The term work consists of following- **(Any Six)**	
1	Prepare a detailed flowchart explaining Screening, Scoping, Public Hearing, and Approval stages.
2	Identify and classify impacts (Direct, Indirect, Cumulative, etc.) for a selected development project.
3	Compare Checklist, Matrix, Network, and Overlay methods with advantages and limitations.
4	Predict possible air and water pollution impacts from an industrial project.
5	Develop a basic Environmental Management Plan for a construction or industrial project.
6	Compare Qualitative vs Quantitative Risk Assessment with suitable examples.
7	Study the step-by-step process of obtaining environmental clearance for projects.
8	Visit a local industrial area and prepare a mini EIA report.
Reference Books:	
1	Canter, L.W., "Environmental Impact Assessment", Mc Graw Hill, New York.
2	Glasson, J., Therivel, R. and Chadwick, A., "Introduction to Environmental Impact Assessment", Routledge, London.
3	Rau, J.G. and Wooten, D.C., "Environmental Impact Analysis Handbook", McGraw Hill, New York.
4	Calow, P., "Handbook of Environmental Risk Assessment and Management", Blackwell Science Ltd., Oxford.
5	Petts, J., "Handbook of Environmental Impact Assessment", Blackwell Science, Oxford.
6	K. S. Sankaranarayana and V. N. Bhat, "Environmental Impact Assessment", Oxford University Press, New Delhi.
7	Christopher Wood, "Environmental Impact Assessment: A Comparative Review", Pearson Education.
8	P. R. Trivedi and R. K. Trivedi, "Environmental Impact Assessment", APH Publishing Corporation, New Delhi.
9	Lawrence, D. P., "Environmental Impact Assessment: Practical Solutions to Recurrent Problems", Wiley-Blackwell.
Reference Codes: Latest editions of following Codes	

1	ISO 14001- 2015: Environmental Management Systems.
2	IS 15442-2004: Parameters for Environmental Impact Assessment of Water Resources Projects.
3	IS 15656-2006: Hazard identification and risk analysis.
4	IS/ISO 31000-2018: Risk Management Guidelines.

PROGRAM ELECTIVE: BIG GEOSPATIAL DATA ANALYTICS		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Termwork : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Basic understanding of Geographic Information Systems (GIS) including spatial data types and map projections.
2	Basic knowledge of Database Management Systems and data organization concepts.
3	Basic programming skills (preferably Python or similar languages used in data analysis.
4	Familiarity with computers, internet-based tools, and geospatial software environments.
Course Objective: On completion of the course -	
	the students will be able to gain knowledge and practical understanding of managing and analyzing large-scale geospatial datasets using modern big data technologies.
Course Outcomes: On completion of the course, the students will be able to -	
1	understand the fundamental concepts, characteristics, and sources of big geospatial data.
2	apply spatial database and data management techniques for storing and organizing large geospatial dataset.
3	implement distributed computing and big data processing frameworks for analyzing large-scale spatial data.
4	apply spatial data mining and machine learning techniques to discover patterns and relationships in geospatial data.
5	perform cloud-based geospatial analytics using modern web gis and cloud computing platforms.
6	apply big geospatial data analytics techniques to solve real-world problems such as smart city planning, disaster management, environmental monitoring, and transportation analysis.

Course Content:

Unit-I	**Fundamentals of Big Geospatial Data:** Introduction to the basic concepts of geospatial data and Geographic Information Systems (GIS) along with the fundamentals of big data, types, sources, and characteristics of big geospatial data generated from satellites, GPS, and sensors, basic data acquisition, storage, processing, and visualization techniques with applications in environmental monitoring and urban planning.	**(06 Hrs)**
Unit-II	**Geospatial Data Storage and Management:** The fundamentals of storing, organizing, and managing geospatial data using spatial databases and data management systems. Introduction to data models, database structures, indexing techniques, and metadata concepts for efficient handling of large spatial datasets. Overview of cloud-based storage and data security aspects in geospatial data management.	**(06 Hrs)**
Unit-III	**Big Data Processing Frameworks for Geospatial Data** Introduction to big data processing frameworks used for handling large-scale geospatial datasets, distributed computing concepts and tools such as Hadoop and Spark for storage and parallel processing of spatial data, geospatial data	**(06 Hrs)**

	analytics workflows and real-time processing applications in environmental and urban systems.	
Unit-IV	**Geospatial Data Mining and Machine Learning:** This unit introduces techniques for extracting patterns and knowledge from geospatial datasets using data mining and machine learning methods. It covers spatial data preprocessing, feature extraction, and basic algorithms such as classification, clustering, and regression applied to spatial data. Applications in environmental monitoring, urban analysis, and predictive modeling are also discussed.	**(06 Hrs)**
Unit-V	**Cloud-based Geospatial Analytics:** Introduction to cloud computing concepts applied to geospatial data processing and analysis, cloud platforms, web-based GIS services, and scalable storage and computation for large spatial datasets. Real-time geospatial analytics and applications in smart cities, disaster management, and environmental monitoring.	**(06 Hrs)**
Unit-VI	**Applications of Big Geospatial Data Analytics:** Practical applications of big geospatial data analytics across various sectors, the use of spatial analytics in urban planning, transportation systems, environmental monitoring, disaster management, and resource management. Decision-support systems and real-world case studies using large-scale geospatial datasets.	**(06 Hrs)**

Term Work: The term work consists of following- List of Activities to be Done in Term Work (any one from each unit)

1	Unit I: Fundamentals of Big Geospatial Data ➢ Explain geospatial data and GIS concepts. ➢ Describe big data fundamentals (Volume, Velocity, Variety, etc.). ➢ Discuss sources of geospatial data (satellites, GPS, sensors). ➢ Explain data acquisition, storage, and visualization concepts. ➢ Write applications in environmental monitoring and urban planning.
2	Unit II: Geospatial Data Storage and Management ➢ Explain spatial data models and database structures. ➢ Describe spatial indexing techniques. ➢ Explain metadata concepts. ➢ Study geospatial data organization methods. ➢ Discuss cloud storage and data security concepts.
3	Unit III: Big Data Processing Frameworks ➢ Explain distributed computing concepts. ➢ Study Hadoop and Spark frameworks (theoretical overview). ➢ Describe parallel processing of spatial data. ➢ Explain geospatial analytics workflow. ➢ Discuss real-time data processing applications.
4	Unit IV: Geospatial Data Mining and Machine Learning

	➢ Explain spatial data preprocessing. ➢ Describe feature extraction methods. ➢ Study classification, clustering, and regression concepts. ➢ Explain machine learning applications in geospatial analysis. ➢ Discuss predictive modeling applications.
5	Unit V: Cloud-based Geospatial Analytics ➢ Explain cloud computing concepts. ➢ Describe web GIS and cloud platforms. ➢ Study scalable storage and computation concepts. ➢ Explain real-time geospatial analytics. ➢ Discuss smart city and disaster management applications.
6	Unit VI: Applications of Big Geospatial Data Analytics ➢ Study applications in urban planning. ➢ Explain transportation system analytics. ➢ Discuss environmental monitoring applications. ➢ Explain disaster management applications. ➢ Study decision-support systems using geospatial data.
Reference Books:	
1	P. Longley, M. Goodchild, D. Maguire and D. Rhind, "Geographic Information Systems and Science", Wiley Publications.
2	S. Shekhar and S. Chawla, "Spatial Databases",A Tour, Pearson Education.
3	J. Han, M. Kamber and J. Pei, Data Mining, "Concepts and Techniques", Morgan Kaufmann Publishers
4	M. DeMers, "Fundamentals of Geographic Information Systems", Wiley Publications.
5	Q. Huang and C. Zhang, "Big Spatial Data Analytics", Springer Publications.

PROGRAM ELECTIVE: SOIL DYNAMICS AND MACHINE FOUNDATION		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Geotechnical Engineering
2	Foundation Engineering
Course Objective: On completion of the course -	
	students will be able to understand the behavior of soils under dynamic loading and earthquake forces and apply the principles for seismic analysis and design of machine foundations.
Course Outcomes: On completion of the course, the students will be able to -	
1	explain basic principles of soil dynamics and vibration theory.
2	evaluate dynamic soil properties and wave propagation characteristics using laboratory and field testing method.
3	assess liquefaction potential of soil.
4	perform seismic analysis of geotechnical structures.
5	design block type machine foundations.
6	analyze and design pile-supported machine foundations.

Course Content:

Unit-I	**Introduction** Theory of vibrations – Free and forced vibrations, damped and undamped systems, single and multi-degree freedom systems. Nature of dynamic loads. Stress conditions on soil elements under earthquake loading. Seismic forces for pseudo-static analysis as per relevant IS Code.	**(06 Hrs)**
Unit-II	**Wave Propagation and Dynamic Soil Properties** Propagation of seismic waves in soil deposits. Attenuation of stress waves. Stress–strain behavior of cyclically loaded soils. Dynamic moduli and elastic constants. Poisson's ratio and damping ratio. Field tests for dynamic properties. Factors affecting shear modulus and elastic modulus.	**(06 Hrs)**
Unit-III	**Liquefaction of Soil** Definition and mechanism of liquefaction. Laboratory studies – Dynamic triaxial test and cyclic simple shear test. Evaluation of liquefaction in field. Vibration table studies and field blast studies. Evaluation using Standard Penetration Test (SPT). Factors affecting liquefaction.	**(06 Hrs)**
Unit-IV	**Seismic Analysis and Design of Geotechnical Structures** Pseudo-static method and pseudo-dynamic method. Seismic analysis of retaining walls, foundations, and embankments. Codal provisions and guidelines for seismic design of geotechnical structures.	**(06 Hrs)**

Unit-V	**Design of Machine Foundations** Analysis and design of block foundations for reciprocating engines. IS 2974 provisions for machine foundation design, Vibration isolation and absorption techniques.	**(06 Hrs)**
Unit-VI	**Machine Foundations on Piles** Introduction to pile-supported machine foundations. Analysis of piles under vertical vibrations. Analysis under translation and rocking. Design procedure for pile-supported machine foundation.	**(06 Hrs)**

Term Work: The term work consists of following- **(Any six)**	
1	Characteristics of dynamic loads and their impact on soil.
2	Propagation of seismic waves in soil deposits and their engineering significance.
3	Field and laboratory methods for determination of dynamic soil properties.
4	Evaluation of liquefaction potential in soils using laboratory and field techniques.
5	Seismic behavior and design considerations of foundations in earthquake-prone areas.
6	Design principles of machine foundations based on dynamic loading.
7	Comparative study of isolated and pile-supported machine foundations.
8	Codal provisions and design guidelines for seismic analysis of geotechnical structures as per indian standards.
Reference Books:	
1	Shamsher Prakash, “Soil Dynamics”, McGraw-Hill Book Company.
2	Braja M. Das, “Principles of Soil Dynamics”, PWS-KENT Publishing Company
3	Bharat Bhushan Prasad “Advanced Soil Dynamics and Earthquake Engineering”, PHI Learning Pvt. Limited
Reference Codes: Latest editions of following Codes	
1	IS 2974 “Code of Practice for Design and Construction of Machine Foundations”
2	IS 5249 “Determination of Dynamic Properties of Soils”
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://onlinecourses.nptel.ac.in/noc23_ce41/preview
2	https://nptel.ac.in/courses/105101005

PROGRAM ELECTIVE: PRECAST & PRESTRESSED CONCRETE DESIGN		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Structural Analysis
2	Design of RC Structures
3	Mechanics of Solids
Course Objective: On completion of the course -	
	the students should be able to design Prestressed Concrete structures.
Course Outcomes: On completion of the course, the students will be able to -	
1	know merits, demerits and application of precast elements.
2	know prestressing materials and methods.
3	estimate losses due to prestress.
4	analyse stresses in prestressed girder in flexure
5	design a prestressed girder.
6	decide type of connection.

Course Content:

Unit-I	**Introduction to Precast and Prestressed Concrete:** Limitations of reinforced concrete and advantages of precast and prestressing, Basic principles of prestressing, Pre-tensioning and post-tensioning systems, Types of prestressing: Internal prestressing, External prestressing, Advantages and disadvantages of precast concrete construction, Materials used in prestressed concrete: High strength concrete, Pre-stressing steel (wires, strands, tendons), Codal provisions overview as per IS 1343.	**(06 Hrs)**
Unit-II	**Prestressing Systems:** Prestressing systems, Pre-tensioning system, Post-tensioning system, Anchorage systems and devices, Transmission length and anchorage zone stresses.	**(06 Hrs)**
Unit-III	**Losses of prestress:** Elastic shortening, Creep of concrete, Shrinkage of concrete, Relaxation of steel, Friction loss, Estimation of total prestress losses as per IS 1343, Codal recommendations for loss calculations.	**(06 Hrs)**
Unit-IV	**Analysis of Prestressed Concrete Sections:** Assumptions in prestressed concrete analysis, Stress concept in prestressed members, Stresses due to: Prestressing force, Bending moment, Combined loading, Stress distribution at: Initial stage, Final stage, Pressure line and thrust line, Kern distance and eccentricity limits, Codal stress limits as per IS 1343.	**(06 Hrs)**
Unit-V	**Design of Prestressed Concrete Members:** Design of prestressed concrete beams: Pre-tensioned beams, Post-tensioned	**(06 Hrs)**

	beams, Design for flexure: Permissible stress method, Limit state method, Design for shear, Ultimate load carrying capacity, Serviceability requirements: Deflection, Crack control, Codal provisions for design as per IS 1343	
Unit-VI	**Precast Concrete Members and Connections:** Introduction to precast concrete construction, Types of precast members: Beams, Columns, Slabs, Wall panels, Design considerations for precast members, Handling, transportation, and erection stresses, Connections in precast construction: Beam-column connections, Column-foundation connections, Slab connections, Structural behavior of precast systems, Codal provisions for precast prestressed members.	**(06 Hrs)**

Term Work: The term work consists of following- **(Any Three)**	
1	Prepare a technical report comparing Pre-tensioning vs. Post-tensioning. The report must include sketches of common anchorage systems (like Freyssinet or Gifford-Udall) and a flowchart of the stress transfer mechanism (Transmission length vs. Anchorage zone).
2	Given a post-tensioned beam profile, calculate the total percentage loss of prestress. Students must manually compute losses due to elastic shortening, friction, anchorage slip, and long-term effects like creep, shrinkage, and relaxation as per IS 1343.
3	Given a post-tensioned beam profile, calculate the total percentage loss of prestress. Students must manually compute losses due to elastic shortening, friction, anchorage slip, and long-term effects like creep, shrinkage, and relaxation as per IS 1343.
4	Given a post-tensioned beam profile, calculate the total percentage loss of prestress. Students must manually compute losses due to elastic shortening, friction, anchorage slip, and long-term effects like creep, shrinkage, and relaxation as per IS 1343.
5	Given a post-tensioned beam profile, calculate the total percentage loss of prestress. Students must manually compute losses due to elastic shortening, friction, anchorage slip, and long-term effects like creep, shrinkage, and relaxation as per IS 1343.
6	Given a post-tensioned beam profile, calculate the total percentage loss of prestress. Students must manually compute losses due to elastic shortening, friction, anchorage slip, and long-term effects like creep, shrinkage, and relaxation as per IS 1343.
7	Visit to precast/prestressed site and prepare detailed technical report on it.
Reference Books:	
1	N. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publications.
2	T. Y. Lin and N. H. Burns, “Design of P.S.C structures”, John Wiley and Sons, New York.
3	P. Dayaratnam, “Prestressed Concrete”, Medtech Pub
4	N.C. Sinha and S.K. Roy, “Fundamentals of Prestressed Concrete”,S.Chand Pub.
Reference Codes: Latest editions of following Codes	
1	IS 1343: Prestressed Concrete - Code of Practice.
2	IS 456: Indian Standard code of practice for plain and reinforced concrete, Bureau of Indian Standards, New Delhi.
3	IS 875-1987 (Part I to V): Code of Practice for Design Loads
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://onlinecourses.nptel.ac.in/

PROGRAM ELECTIVE: ANALYSIS AND DESIGN OF BRIDGES		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term Work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Structural Analysis
2	Design of Steel Structures
3	Design of RC Structures
4	Analysis and Design of Prestressed Concrete
5	Transportation and Geotechnical Engineering
Course Objective: On completion of the course -	
	The students should be able to select and design appropriate bridge structures for given site conditions.
Course Outcomes: On completion of the course, the students will be able to -	
1	classify different types of bridges.
2	calculate the stresses on bridges as per IRC.
3	design of RC slab bridge deck.
4	analyze and design of RC and post tension PC girders.
5	design the components of railway plate girder bridge.
6	design the bridge bearings.

Course Content:

Unit-I	**Introduction to Bridge Engineering:** Classification of bridges, Components of Bridges, Preliminary data to be collected during investigation of site for bridges, Economical span, Afflux, HFL, Scour depth and Clearance, Locations of piers and abutments, Factors influencing the choice of bridge super structure, Approach roads, IRC, AASHTO provisions, Case studies of bridge failures.	**(06 Hrs)**
Unit-II	**Superstructure and Substructure:** Components of Superstructure, loads on bridges: Brief specifications of different loads, Forces and stresses coming on bridges as per IRC, Substructure: Abutment, Piers, and Wing walls with their types and stability analysis of substructure.	**(06 Hrs)**
Unit-III	**Design of RC Slab Bridge Deck for Highways:** Analysis of slab decks considering cases solid slab spanning in one direction, solid slabs in spanning two direction and solid cantilever slab, design. Aids and Tables of RC deck bridge slab as per Pigeaud‘s method, Design of RC slabs supported on all sides for T- beam and slab deck. Limit State Design approach as per IRC:112.	**(06 Hrs)**
Unit-IV	**RC Bridge Girders and Post Tensioned Prestressed Girders:** Load distribution on longitudinal and cross girders, methods of analysis, analysis and design of longitudinal and cross girders as per Courbon’s theory,	**(06 Hrs)**

	design of post tensioned prestressed concrete T beam bridge deck and girders.	
Unit-V	**Plate Girder Bridges:** Railroad bridge philosophy, Railroad bridge types, Elements of plate girder and their design such as web, flange, vertical stiffeners, end bearing stiffeners, intermediate stiffeners, and lateral bracing for plate girders.	**(06 Hrs)**
Unit-VI	**Bridge Bearings:** General features and function of bearings, Types of bearings, Design of steel rocker and roller bearings, Design of elastomeric pad bearing, Spherical bearings, Pot bearings, Disc bearings, Seismic isolation bearings, Expansion joint concepts, Bridge Deck Joints and Overlays.	**(06 Hrs)**

Term Work: The term work consists of following-	
1	Site Investigation for Bridges: Case example of real bridge survey.
2	Case studies of 2–3 bridge failures (causes and lessons learned).
3	IRC load combinations and specifications: Numerical examples for load calculations.
4	Pigeaud's Method for Slab Design: Numerical problems using Pigeaud's method.
5	RC T-Beam Bridge (Girder Analysis): Numerical problems.
6	Prestressed Concrete Bridge Girder: Numerical problems.
Reference Books:	
1	B. L. Gupta and Amit Gupta, "Highway and Bridge Engineering", Standard publishers Distributors.
2	Rangwala, "Bridge Engineering", Charotar Publication.
3	N. Krishna Raju, "Design of Bridges", Oxford and IBH Publishing Company Pvt. Ltd., New Delhi.
4	D. Johnson and Victor, "Essentials of Bridge Engineering", Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
5	Wai-Fah Chen and Lian Duan, "Bridge Engineering Handbook", CRC Press Pvt. Ltd.
6	Ponnuswamy S., "Bridge Engineering", Tata McGraw-Hill, New Delhi.
7	Ramachandra, "Design of Steel Structures", Standard Publications, New-Delhi.
8	Jain and Jaikrishna, "Plain and Reinforced Concrete", Vol.2., NemChand Brothers, New Delhi.
Reference Codes: Latest editions of following Codes	
1	Standard specifications and code of practice for road bridges, IRC section I, II, III, V, VI, VII, and IX.
2	IS 456: Code of practice for Plain and Reinforced Concrete, BIS, Bureau of Indian Standards, New Delhi.
3	Indian Railway Standard Code of practice for the design of steel and wrought iron bridges carrying rail, Govt of India, Ministry of Railways.
4	American Association of State Highway and Transportation Officials (AASHTO).
5	Ministry of Road Transport and Highways, India.
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://nptel.ac.in/courses/105105216

PROGRAM ELECTIVE: WATERSHED MANAGEMENT		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Lecture : 03 Hrs / Week Tutorial : 01 Hrs / Week	End Semester Examination : 60 Marks Internal Assessment : 40 Marks Term work : 25 Marks	Lecture : 03 Tutorial : 01
	Total : 125 Marks	Total : 04

Course Pre-requisites: The students should have knowledge of	
1	Irrigation Engineering, Engineering Hydrology
2	Mechanics of Fluids
Course Objective: On completion of the course -	
	the student should be able to understand the concept, components, and significance of watershed management in sustainable development.
Course Outcomes: On completion of the course, the students will be able to -	
1	understand the concept and characteristics of watersheds and their role in water resource management.
2	analyze hydrological processes affecting watershed behaviour.
3	apply soil and water conservation measures for watershed development.
4	use gis and remote sensing techniques for watershed analysis and planning.
5	evaluate watershed management strategies for sustainable development.
6	evaluate participatory watershed management approach.

Course Content:

Unit-I	**Introduction to Watershed Management:** Definition and concept of watershed, Watershed characteristics and classification, Importance of watershed management in water resource planning, Watershed problems: soil erosion, land degradation, flooding and drought, Objectives and principles of watershed management.	**(06 Hrs)**
Unit-II	**Hydrological Processes in Watersheds:** Hydrological cycle in a watershed, Rainfall–runoff relationship, Infiltration, evapotranspiration and groundwater recharge, Watershed hydrological response and stream flow generation, Sediment yield and erosion processes.	**(06 Hrs)**
Unit-III	**Soil and Water Conservation Measures:** Causes and effects of soil erosion, Mechanical measures: contour bunding, terracing, check dams, gully control structures, Agronomic measures: crop rotation, strip cropping, mulching, contour farming, Vegetative measures: afforestation, grass waterways, shelter belts, Water harvesting techniques and farm ponds.	**(06 Hrs)**
Unit-IV	**Watershed Planning and Development:** Watershed planning principles and stages, Identification and prioritization of watersheds, Watershed development programs and strategies, Integrated watershed management approach, Community participation in watershed development.	**(06 Hrs)**

Unit-V	**Application of GIS and Remote Sensing in Watershed Management:** Introduction to GIS and Remote Sensing in watershed studies, Digital Elevation Model (DEM) and watershed delineation, Morphometric analysis of watershed, Land use and land cover mapping, Application of GIS for watershed planning.	**(06 Hrs)**
Unit-VI	**Watershed Management Programs and Case Studies:** National watershed development programs, Participatory watershed management approaches, Impact assessment of watershed development projects, Case studies of successful watershed projects in India.	**(06 Hrs)**

Term work: The term work shall consist of **any Two** projects.	
1	Case Study Assignment: Students must prepare a report on : Watershed Management Project Including Background, Problems, Measures Adopted, Outcomes.
2	Design / Problem Solving: Students should perform basic calculations such as: Runoff estimation Water harvesting potential, Design of small structures (check dam, bund) with calculation sheets.
3	Seminar / Presentation: Topics such as: GIS in watershed management, Climate change and watersheds, Participatory watershed management.
Reference Books:	
1	Suresh Kumar, "Watershed Management, Issues and Policies For 21st Century", Associated Publishing Company
2	Dr. R. Suresh, "Soil & Water Conservation Engineering" Standard Publishers Distributors
3	Mohan Mohan Das, Mimi Das Saikia, "Watershed Management", PHI Publishers
4	Er. Ashwani Kumar Baranwal, Er. Shesh Nath Rawat, "Basic Principles of Soil and Water Conservation Engineering Practices", Jain Brothers
5	Murthy, J.V.S. "Watershed Management in India", NEW AGE International Publishers
Reference Codes: Latest editions of following Codes	
1	IS 4987-1994: Recommendations for Estimation of Design Flood
2	IS 12169-1987: Guidelines for Contour Bunding for Soil and Water Conservation
3	IS 15797-2008: Guidelines for Rainwater Harvesting Systems
4	IS 8414-1977: Guidelines for Design of Small Dams
Self-Learning Resources*:* List of Open-Source Software/learning website:	
1	https://nptel.ac.in/
2	https://iitr.ac.in/Departments/Hydro%20and%20Renewable%20Energy%20Department/Academics/HY-531%20Watershed%20Management.html

COURSE: MAJOR PROJECT		
TEACHING SCHEME:	**EXAMINATION SCHEME:**	**CREDITS:**
Practical:16 Hrs. / Week	Term Work :100 Marks Oral : 50 Marks	Practical : 08
	Total : 150 Marks	Total : 08

Course Pre-requisites: The students should have knowledge of	
1	Core Civil Engineering Courses
2	Analytical skills
3	Soft and Computing Skill
Course Objective: On completion of the course -	
	To enable students to execute the proposed methodology, analyse and validate results, develop optimized and sustainable solutions, and present the work in a professional research-oriented format.
Course Outcomes: On completion of the course, the students will be able to -	
1	execute the planned methodology using appropriate tools and techniques.
2	collect, analyse, and validate experimental/analytical/simulation results.
3	interpret findings using statistical and engineering principles.
4	optimize solutions considering cost, sustainability, and societal impact.
5	demonstrate teamwork, leadership, and project management skills.
6	prepare high-quality technical reports, research presentations & research paper

Course Content:

Unit-I	**Problem Formulation & Objective Setting:** Identification of thrust areas in Civil Engineering, Research gap analysis, Review of journal papers (minimum 10–15 from Scopus/SCI/UGC Care), Framing of problem statement, Formulation of SMART objectives, Hypothesis development (if applicable), Scope, limitations, and constraints, Feasibility study (technical, financial, time).	**(32Hrs)**
Unit-II	**Research Methodology &Project Execution:** Selection of methodology (Experimental / Analytical / Modelling / Simulation), Identification of tools/software, Data collection techniques (Primary/Secondary), Sampling techniques, Validation methods, Detailed execution plan, Progress Review, Quality Control measures.	**(32Hrs)**
Unit-III	**Experimental Work / Design / Simulation& Resource Planning:** Laboratory experimentation / Field work, Structural / Transportation / Geotechnical / Environmental analysis, Software-based modeling, Data recording in standardized format, Identification of manpower, material, equipment, Cost estimation techniques, Budget preparation, Funding opportunities (if applicable).	**(32Hrs)**
Unit-IV	**Data Analysis & Validation:** Statistical tools (mean, regression, correlation, error analysis), Graphical representation (charts, trend analysis), Comparison with codes (IRC, IS Codes, MoRTH, etc.), Validation using analytical/theoretical results	**(32Hrs)**

Unit-V	**Interpretation of Results& Impact Analysis:** Critical interpretation of results, Comparison with literature findings, Sensitivity analysis, Discussion on limitations, Cost optimization, Environmental impact assessment, Life Cycle Cost Analysis (if applicable), Social feasibility, SDG Mapping, Scope for future work.	**(32Hrs)**
Unit-VI	**Technical Report Writing & Dissemination:** Preparation of final consolidated report (Stage I + Stage II), Formatting as per IEEE/APA style, Plagiarism check (<10–15%), Preparation of journal/conference paper draft, Poster / Technical Presentation preparation.	**(32Hrs)**
Term work:		
	The Major Project consists report on above topics and prepare **Hard Bound copy** of Project Report based on consolidated work of Major Project (Maximum Five Students per Project Group).	
Oral Examination:		
	The oral examination will be based on above term work and presentation with reference to course content.	

B. Tech. – 2023 Course

Rules and Regulations

B. Tech. – 2023 Course

Rules and Regulations

(I) Theory

(A) Theory Examination

Theory examination consists of: (i) End semester examination (ESE), and (ii) Internal assessment (IA).

(i) ESE is of 60 marks for theory courses.

(ii) IA is of 40 marks. Following assessment tools shall be used for evaluation of IA.

a) Unit test
b) Project based learning
c) Case study
d) Presentation/ Seminar
e) Quiz
f) Open book test
g) Assignment
h) MCQ
i) Poster presentation
j) Modelling
k) Group discussion
l) Role play
m) Term paper/Research Paper

Note

1. Each semester shall include two Internal Assessments: Internal Assessment–I and Internal Assessment–II.
2. Internal Assessment–I will be based on Units I, II, and III, while Internal Assessment–II will cover Units IV, V, and VI.
3. It is mandatory to categorize the courses within each discipline into appropriate groups based on their nature. For each group, a set of 2 to 4 suitable assessment tools shall be identified and used for evaluation.
4. The Course Coordinator shall prepare a unit-wise plan for conducting the Internal Assessments

using the selected tools and submit it to the Head of the Department before the commencement of the academic term. A maximum of 2–3 tools may be selected for each course.

5. The Course Coordinator is also responsible for maintaining proper documentation of the Internal Assessments and shall submit the same to the Head of the Department at the end of the semester, if required.

6. All Internal Assessments must be designed, conducted, and evaluated in alignment with the appropriate levels of Bloom's Taxonomy.

(B) Standard of Passing

(i) There is a separate passing of 40% of 60 marks, i.e. 24 marks, for ESE for a given course.

(ii) There is a separate passing of 40% of 40 marks, i.e. 16, for IA for a given course.

(iii) A student who fails at ESE in a given course has to reappear only at ESE as a backlog student and clear the head of passing. Similarly, a student who fails at IA in a given course has to reappear only at IA as a backlog student and clear the head of passing

(II) Practical

(A) Practical Examination

Practical examination consists of: (i) Term work, and (ii) Practical/Oral examination for a given course based on term work.

(i) Term work (TW): TW marks are as mentioned in the curriculum structure.

(ii) Practical/Oral (PR/OR): PR/OR marks are as mentioned in the curriculum structure.

(B) Conduction of practical/oral examination

(i) A student will be permitted to appear for practical/oral examination only if he/she submits term work of a given course.

(ii) Practical/oral examination shall be conducted in the presence of internal and external examiners appointed by university.

(B) Standard of Passing

(i) A student shall pass both heads TW and PR/OR separately with minimum 40% of total marks of respective head.

(III) MOOC and Social Activity Course

(i) If a student completes one MOOC during a programme, he/ she will earn additional TWO credits, subjected to submission of the certificate of completion of the respective course. It is mandatory for a student to complete atleast two MOOC to obtain degree in a given discipline. Students shall register to MOOCs which are offered by any one the following agencies:

(a) SWAYAM : www.swayam.gov.in

(b) NPTEL : www.onlinecourse.nptel.ac.in

(c) Course Era : www.coursera.org

(d) edX online learning : www.edx.org

(e) MIT Open Course ware : www.ocw.mit.edu

(f) Udemy : www.udemy.com

(g) Spoken tutorial : www.spoken-tutorial.org

(ii) If a student completes social activity, he/she will earn additional TWO credits, subjected to submission of the certificate of completion of the respective course/ activity from the relevant authorities. It is mandatory for a student to complete atleast one social activities to obtain degree in a given discipline.

(iv) The additional credits for MOOC and Social Activity will be given only after verification of the authentic document by the Head of the Department and a separate mark-sheet will be submitted by the Head of the Department along with the course examiner.

(IV) Value Added Course (VAC) and Indian Knowledge System (IKS) Course

(i) The VAC and IKS courses are mandatory and must be passed by students during the designated semester to earn two credits.

(ii) These courses have an internal assessment worth 100 marks, which are distributed as follows: (a) three assignments, each worth 20 marks, and (b) two case studies, presentations, or quizzes, each worth 20 marks. Faculty members have the flexibility to choose between conducting two case studies, two presentations, two quizzes, or any combination thereof.

(V) Minor Programme

(i) A students shall receive a MINOR degree when he/she acquires additional 20 credits in a given specialization defined by the UG programmes offered at the institute.

(ii) The theory and practical/oral components for a given course are mentioned in curriculum structure. The theory and examination for a given course are mentioned in Section I and II.

(iii) The grade point, grade letter and equivalent marks system for MINOR programme is mentioned in Section V.

(iv) The MINOR DEGREE programme is OPTIONAL. The interested students may opt MINOR programme.

(v) A student shall complete the MINOR program prior to his/her graduation.

(VI) A. T. K. T

(i) A student who is granted term for B. Tech. Semester-I, III, V, VII will be allowed to keep term for his/her B. Tech. Semester-II, IV, VI, VIII examination, respectively even if he/she appears and fails or does not appear at B. Tech. Semester-I,III, V, VII examination respectively.

(ii) A student shall be allowed to keep term for the B. Tech. Semester-III course if he/she has a backlog of any number of Heads of passing at B. Tech. Semester-I & II taken together.

(iii) A student shall be allowed to keep term for the B. Tech. Semester-V of respective course if he/she has no backlog of B. Tech. Semester-I & II and he/she has a backlog of any number of Heads of passing at B. Tech. Semester-III & IV taken together.

(iv) A student shall be allowed to keep term for the B. Tech. Semester- VII of respective course if he/she has no backlog of B. Tech. Semester-I, II, III, IV and he/she has a backlog of any number of Heads of passing at B. Tech. Semester-V & VI taken together.

(VII) Grade Point, Grade Letter and Equivalent Marks

The student must obtain a minimum Grade Point of 5.0 (40% marks) in ESE and also in combined ESE + IA. A student who fails in ESE of a course has to reappear only to ESE as a backlog student and clear that head of passing.

Award of the Class for the Degree considering CGPA: A student who has completed the minimum credits specified for the programme shall be declared to be passed in the programme. The CGPA will be computed every year of all the courses of that year. The grade will be awarded according to the CGPA of every year.

Range of CGPA	Final Grade	Performance Descriptor	Equivalent range of Marks (%)
$9.50 \leq CGPA \leq 10.00$	O	Outstanding	$80 \leq Marks \leq 100$
$9.00 \leq CGPA \leq 9.49$	A+	Excellent	$70 \leq Marks < 80$
$8.00 \leq CGPA \leq 8.99$	A	Very Good	$60 \leq Marks < 70$
$7.00 \leq CGPA \leq 7.99$	B+	Good	$55 \leq Marks < 60$
$6.00 \leq CGPA \leq 6.99$	B	Average	$50 \leq Marks < 55$
$5.00 \leq CGPA \leq 5.99$	C	Satisfactory	$40 \leq Marks < 50$
CGPA below 5.00	F	Fail	Marks Below 40