Malnad College of Engineering,

Hassan

[An Autonomous Institution Affiliated to VTU Belagavi]

Autonomous Programme Bachelor of Engineering in Civil Engineering

Scheme & Syllabus

V & VI Semester

(2023-24 Admitted Batch)

Academic Year:2025-26 Department of Civil Engineering

Vision of the Department

The Department of Civil Engineering will be a centre of excellence in industry-oriented teaching, training, research, professional ethics, social responsibility, and continuing education for practicing engineers through sponsored research and consultancy services

Mission of the Department

1. To improvise the curriculum to include contents pertaining to situational experience of variety of sites and develop a sense of social responsibility and to enhance research orientation of students through internship programs.
2. To enhance sponsored research and consultancy works to achieve effective industry-institute-interaction and conduct Continuing Education Programme for practicing engineers.
3. To inculcate professional ethics through quality and modern construction practices.
4. To switch over to modern methods of material testing, Engineering analysis and design.

Program Educational Objectives (PEOs)

PEO1: The graduate will be successful professionally and contribute to core civil engineering construction projects, infrastructure projects, alternative construction technology projects, green buildings towards environmental sustainability for academic domain as well as for research and pursue higher studies.

PEO2: The graduate will be professionally sound in broad area of knowledge of various dimensions of civil engineering and allied fields.

PEO3: The graduate will be a team leader/effective team member with ethical values, versatile, quick learner will adapt to given professional context with lifelong learning capability.

PROGRAM OUTCOMES (POs)

1. **Engineering knowledge**: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3. **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)
4. **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).
5. **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)
6. **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).
7. **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **Individual and collaborative team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary settings.
9. **Communication:** Communicate effectively and inclusively within the 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.
10. **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.
11. **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)

PROGRAM SPECIFIC OUT COMES

PSO1: The Graduates will be demonstrate ability to design a civil engineering system, components or process to meet desired
Project needs.

PSO2: Graduates will be familiar with civil engineering professional software tools and demonstrate their ability in applying them for the solution of design situations.

Malnad College of Engineering, Hassan
Department of Civil Engineering

Scheme of Evaluation for Theory Courses

	Portions for CIE	Mode of Evaluation	Weight age in Marks
CIE-1	Syllabus to be decided by the Course Coordinators such that the entire COs shall be covered.	Descriptive Test	10
CIE-2		Descriptive Test	10
CIE-3		Descriptive Test	10
Activity	Minimum of Two Activities to be conducted	Assignment/Case Study/Practical/ Working Model/Quiz	20
		Total	50

Examination		Max. Marks	Minimum Marks to be scored	Minimum Average Marks to qualify
CIE	Tests	30	12 (>=40%)	40 (= 40%)
	Activities	20	08 (>=40%)	
SEE		50	17.50 (>=35%)	

Scheme of Evaluation for Laboratory Courses

Evaluation Type	Evaluation Modules	Marks
Continuous Internal Evaluation (C.I.E.) in every Laboratory session by the Course Coordinator	**Conduction of Experiments**	**10**
	Observation and Tabulation of Results	**10**
	Record Writing	**20**
	Viva-Voce/Quiz	**10**
Continuous Internal Evaluation(C.I.E.)		**50**
Semester End Examination (S.E.E.)		**50**

Note: The marks distribution to be made based on the rubrics for a particular laboratory course.

COURSE TYPES

Basic Science Course	BSC
Engineering Science Course	ESC
Emerging Technology Course	ETC
Programming Language Course	PLC
Professional Core Course	PCC
Integrated Professional Core Course	IPCC
Professional Core Course Laboratory	PCCL
Professional Elective Course	PEC
Open Elective Course	OEC
Project/Mini Project/Internship	PI
Humanities and Social Sciences, Management Course	HSMC
Ability Enhancement Course	AEC
Skill Enhancement Course	SEC
Universal Human Value Course	UHV
Non-credit Mandatory Course	MC

FIFTH SEMESTER											
Sl.No	Course Category	Course Code	Course Title	Teaching Hours/Week				Exam Marks			Credits
				L	T	P	Total	CIE	SEE	Total	
1	PCC	23CV501	Advanced Structural Analysis	3	0	0	3	50	50	100	3
2	PCC	23CV502	Construction Planning and Management	3	0	0	3	50	50	100	3
3	IPCC	23CV503	Geotechnical Engineering	3	0	2	5	50	50	100	4
4	IPCC	23CV504	Transportation Engineering	3	0	2	5	50	50	100	4
5	PCCL	23CV505	Environmental Engineering Laboratory	0	0	2	2	50	50	100	1
6	HSMC	23CV56X	Professional Elective Course	3	0	0	3	50	50	100	3
7	PEC	23RIP	Research Methodology and IPR	3	0	0	3	50	50	100	3
8	MC	23EVS	Environmental Studies	1	0	0	1	100	-	100	1
Total				19	0	06	25				22

Professional Elective Courses	
Course Code	Course Name
23CV561	Occupational Safety and Health assessment
23CV562	Remote Sensing and GIS
23CV563	Groundwater Development and Management
23CV564	Repair and Rehabilitation of Structures
23CV565	Stability Analysis of Slopes
23CV566	Environmental Impact Assessment

SIXTH SEMESTER											
Sl.No	Course Category	Course Code	Course Title	Teaching Hours/Week				Exam Marks			Credits
				L	T	P	Total	CIE	SEE	Total	
1	IPCC	23CV601	Design and Detailing of RC Structures	3	0	2	5	50	50	100	4
2	PCC	23CV602	Irrigation Engineering and Hydraulic Structures	3	0	0	3	50	50	100	3
3	PCC	23CV603	Applied Geotechnical Engineering	3	0	0	3	50	50	100	3
4	PI	23PROJ1	Main Project Phase-I	0	0	4	4	50	50	100	2
5	PEC	23CV65X	Professional Elective Course - II	3	0	0	3	50	50	100	3
6	OEC	23OECV66X	Open Elective Course-I	3	0	0	3	50	50	100	3
7	PCCL	23CVL606	Software Application Lab	0	0	2	2	50	50	100	1
8	PCC	23CV607	Advanced Survey Training	0	0	2	2	50	50	100	2
9	OEC	23SWY	*Swayam (NPTEL only)	AUDIT							
10	AEC	23ASK	Analytical Ability and Soft Skills	0	0	2	2	50	50	100	1
Total				15	0	12	27				22

Professional Elective Courses	
Course Code	Course Name
23CV651	Theory of Elasticity
23CV652	Structural dynamics
23CV653	Traffic Engineering
23CV654	Rural Water Supply & Sanitation
23CV655	Groundwater Hydraulics
23CV656	Modern Construction Methods and Mechanization
23CV657	Design of Bridges and Flyover

Open Elective Course-I	
Course Code	Course Name
23OECV661	Water Supply and Sanitation
23OECV662	Composite and Smart Materials
23OECV663	Hazardous Waste Management
23OECV664	Sustainability in Engineering Systems
23OECV665	Railway Engineering
23OECV666	Remote Sensing and GIS
23OECV667	Engineering Hydrology

SEVENTH SEMESTER											
Sl.No	Course Category	Course Code	CourseTitle	TeachingHours/Week				ExamMarks			Credits
				L	T	P	Total	CIE	SEE	Total	
1	PCC	23CV701	Specifications & Quantity Surveying	3	2	0	5	50	50	100	4
2	PCC	23CV702	Prestressed Concrete Structures	4	0	0	4	50	50	100	4
3	PCC	23CV703	Design of Steel Structures	3	0	2	5	50	50	100	4
4	PCC	23CV704	Technical Seminar	0	0	2	2	50	50	100	1
5	PI	23PROJ2	Main Project Phase-II	0	0	8	8	50	50	100	4
6	PEC	23CV75X	Professional Elective Course - III	3	0	0	3	50	50	100	3
7	OEC	23OECV76X	Open Elective Course–II	3	0	0	3	50	50	100	3
Total				16	02	14	30				23

ProfessionalElectiveCourse-III	
Course Code	Course Name
23CV751	Railway, Harbour & Airport Engineering
23CV752	Earthquake Resistant Design of Structures
23CV753	Advanced Foundation Design
23CV754	Industrial Wastewater Treatment
23CV755	Advanced Design of RC Structures
23CV756	Composite & Smart Materials
23CV757	Building Information Modelling
23CV758	Watershed Management

OpenElectiveCourse-II	
Course Code	Course Name
23OECV761	Water Supply and Sanitation
23OECV762	Composite and Smart Materials
23OECV763	Hazardous Waste Management
23OECV764	Sustainability in Engineering systems
23OECV765	Railway Engineering
23OECV766	Remote Sensing and GIS
23OECV767	Water Resources Management
23OECV768	Engineering Optimization

EIGHTH SEMESTER												
Sl.No	Course Category	Course Code	CourseTitle	TeachingHours/Week				ExamMarks			Credits
				L	T	P	Total	CIE	SEE	Total	
1	PEC	23SW01	ProfessionalElective (Online Course)	3	0	0	3	50	50	100	3
2	OEC	23SW02	OpenElective (Online course)	3	0	0	3	50	50	100	3
3	PI	23INT	Internship (Research/Industry) (15-20 weeks)	0	0	12	12	100	100	200	10
Total				6	0	12	18				**16**

Course Title	ADVANCED STRUCTURAL ANALYSIS		
Course Code	23CV501	**(L-T-P)C**	(3-0-0)3
Exam	3 Hrs.	**Hours/Week**	03
SEE	100 marks	**Total Hours**	40

Course Objective: To impart knowledge about various methods involved in the analysis of indeterminate structures.

Course Outcomes: At the end of the course the student will be able to

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Analyze the structures subjected to moving loads	PO1, PO2, PO3	PSO1
2	Carryout analysis of indeterminate structures by slope deflection	PO2, PO3, PO4	PSO1
3	Analyze indeterminate structures by moment distribution method	PO2, PO3, PO4	PSO1
4	Analyze indeterminate structures by moment distribution method	PO2, PO3, PO4	PSO1

MODULE-1	**10 Hrs.**

Influence lines and moving loads: Definition & importance of influence line diagram, Influence line diagram for reactions, shear force & bending moment for simply supported beams, Determination of maximum shear force & bending moment at a section and absolute maximum shear force & bending moment in simply supported beams due to moving UDL & series of point loads. **Analysis of continuous beams by Slope Deflection Method:** Development of Slope- Deflection equations - Analysis of Continuous Beams with kinematic indeterminacy not more than three.

Self-study component: Students shall visit different types of structures subjected to moving loads and should observe behaviour of structures.

MODULE-2	**10 Hrs.**

Analysis of frames by Slope Deflection Method: Analysis of orthogonal rigid jointed Plane frames with kinematic indeterminacy not more than three. (both sway & non-sway type). **Analysis of continuous beams by Moment Distribution Method:** Definition of terms distribution factor, carry over factor, Analysis of Continuous Beams with kinematic indeterminacy not more than three.

Self-study component: Students shall work on a standard software for structural analysis and compare the results for simple structural units like continuous beams and portal frames

MODULE-3	**10 Hrs.**

Analysis of frames by Moment Distribution Method: Analysis of orthogonal rigid jointed Plane frames with kinematic indeterminacy not more than three (both sway & non-sway type). **Analysis of continuous beams by Kani's Rotation Contribution Method:** Definition of terms rotation factor, rotation contribution, Analysis of Continuous Beams with kinematic indeterminacy not more than three.

Self-study component: Students shall work on a standard software for structural analysis and compare the results for simple structural units like continuous beams and portal frames

MODULE-4	**10 Hrs.**

Analysis of frames by Kani's Rotation Contribution Method: Analysis of orthogonal rigid jointed Plane frames with kinematic indeterminacy not more than three. (only non-sway type). **Introduction to Plastic analysis of structures:** Ductility of materials, Plastic deformation, Plastic hinge, Plastic analysis of continuous beams and simple quadrangular frames.

Self-study component: Students shall refer to the case study of plastic hinge development of structures.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	"Analysis of Structures"	Vazirani V. N. & Ratwani M. N.	15th	Khanna publications, New Delhi	2002
2	Basic Structural Analysis	Reddy C. S	2nd	Tata Mc Graw Hill Publishing Co.ltd	2006

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Theory of Structures	Ramamrutham. S	9th	Dhanpath Rai Publications, New Delhi	2014
2	Statically indeterminate structures	Wang C.K	1st	Tata McGraw Hill Publishing Co. Ltd, Tokyo	1953

Online Courses and Video Lectures:

1. https://archive.nptel.ac.in/courses/105/101/105101086/
2. https://archive.nptel.ac.in/courses/105/106/105106050/
3. https://archive.nptel.ac.in/courses/105/105/105105109/

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1) Collaborative Activity 2) Assignment	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	3	2	2									1	
CO2		3	2	2								1	
CO3		3	2	2								1	
CO4		3	2	2								1	

Course Title	CONSTRUCTION PLANNING AND MANAGEMENT		
Course Code	23CV502	**(L-T-P)C**	(3-0-0)3
Exam	03 Hrs.	**Hours/Week**	03
SEE	100 marks	**Total Hours**	40

Course Objective: To develop the ability to evaluate construction methods, materials, and equipment, and to effectively apply construction management principles while collaborating within a multidisciplinary team environment.

Course Outcomes: At the end of the course the student will be able to

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Analyze alternative project proposals using engineering economic principles to assess project feasibility through financial indicators such as Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit-Cost Ratio.	PO1, PO2, PO10	
2	Apply linear programming techniques, including graphical and simplex methods, as tools for optimizing resource allocation and decision-making in engineering projects.	PO1, PO10	
3	Apply construction management principles and planning techniques such as CPM and PERT to optimize project cost and schedule efficiency.	PO1, PO10	
4	Develop a structured understanding of construction processes, project management stages, and transportation strategies to achieve optimal project outcomes.	PO1, PO6, PO10,	

MODULE-1	**10 Hrs.**

Introduction to Engineering Economics – Basic concepts of engineering Economic analysis – Micro and Macro analysis – project feasibility –economic and financial feasibility. Engineering Planning Methods: Time value of money - interest formula – present worth – future worth - annual equivalent – rate of return and benefit cost ratio methods for comparison of alternative project proposals – breakeven analysis.

Self-study component: Students shall visit a construction site and discuss the points pertaining to project planning, financing and time schedule, prepare a report and submit.

MODULE-2	**10 Hrs.**

Linear Programming: Standard form of a linear programming– problem Formulation – graphical solution – simplex method – maximization and Minimization-application problems.Construction **Industry and Management:** Introduction – value engineering Time management – labor and material management – contract and contractor-organization and administration.

Self-study component: Students shall visit a construction site and discuss the points pertaining to project management in terms of time, labor and material management, prepare a report and submit.

MODULE-3	**10 Hrs.**

Construction Planning: Introduction – time estimates – Bar and Milestone Charts – CPM and PERT network analysis – cost analysis – direct cost indirect cost – total cost – optimum cost – optimum duration of project.

Construction Equipment: Introduction – factors for selecting equipment – economic life of equipment - various earth moving equipment – hoisting equipment – trenching machines.

Self-study component: Students shall visit a construction site and observe bar charts exhibited at the site, various construction equipment, prepare a report and submit.

MODULE-4	**10 Hrs.**

Work Study in Construction, Project control during construction – Project supervision -safety measures. Transportation Problems: Introduction – Mathematical formulation Optimal solution of transportation problems – methods for initial basic feasible solution – summary of methods of initial BFS – North west corner method – Lowest cost entry method – Vogel's approximation method –optimality test – Degeneracy in Transportation Problems.

Self-study component: Students shall use any typical construction management software and prepare critical path for the execution of the project.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Construction Management	Subramaniam.K	4th	AnuradhaPublishers,Madras,(Ch.1–5) 2)	2012
2	Construction Planning equipments and methods	Peurifoy, R L	6th	McGraw Hill Publications 3rdedition,	2021

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Construction Planning and Management"	Mahesh Varma	2nd	Metropolitan Book Co.Delhi	2019
2	Operation Research	Sharma.S.D	15th	Khanna Publishers, NewDelhi.	2010

EBooks and online course materials:

1. civlandstructureengineering.wordpress.com/wp-content/uploads/2015/08/construction-management-and-planning1.pdf
2. PII: B978-0-7506-6956-6.50000-9

Online Courses and Video Lectures:

1. Construction Management | Coursera
2. Microsoft PowerPoint - 5. Shri P G Venkat Ram- Bridge Construction methods and the failures associated with them
    1.

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1. Students complete assignments using software (e.g., Microsoft Excel, MS Project) involving optimization problems, creating Gantt charts, or modeling systems. 2. Regular short quizzes conducted for each module for understanding of the most recent concepts.	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	2	3								3			
CO2	3									3			
CO3	3									3			
CO4	3					2				3			

Course Title	GEOTECHNICAL ENGINEERING		
Course Code	23CV503	(L-T-P)C	(3-0-2)4
Exam	03 Hrs	Hours/Week	05
SEE	100 marks	Total Hours	40+28

Course Objective: 1. Understand the principles of soil mechanics and their application in engineering. 2. Develop practical skills in soil testing and analysis for accurate characterization of soil properties.

Course Outcomes: At the end of the course the student will be able to

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Evaluate and analyze the importance of basic properties of soil which will affect its strength and compressibility characteristics for design of foundation.	PO1, PO2, PO4	
2	Apply the mechanism of flow of water through soil in the context of design and construction of embankments, canals etc.	PO1, PO2, PO3, PO4	
3	Evaluate the importance of compaction characteristics of soil and the factors which affect the degree of compaction and the compressibility of soils.	PO1, PO2, PO3, PO4	
4	Investigate and report on shear strength parameters of soil involving geo-physical exploration methods of subsurface investigation.	PO1, PO2, PO3, PO4	

MODULE-1	12 Hrs.

Introduction: Basic Definitions, Origin and formation of soil, Phase diagrams, Voids ratio, Porosity, Degree of saturation, Moisture content, Specific gravity, Bulk density, Dry density, Saturated density, Submerged density - inter relationships, field identification of soils.

Index Properties of Soils: Definitions and importance of Index properties, particle size distribution, sedimentation analysis (Hydrometer analysis only) Importance of consistency limits, Classifications of Soils: Necessity, IS classification of soils, plasticity chart and its importance.

Self-Study Component (SSC): The Students shall visit work sites and try to identify different types of soils at the foundation level. They shall try to establish the type of soil by simple field

MODULE-2	13 Hrs.

Flow of Water Through Soil: Darcy's law - Assumptions and validity, seepage velocity, superficial velocity and their relationships, coefficient of percolation. Coefficient of permeability and its determination (excluding field method). Factors affecting permeability, Permeability of stratified soils. **Effective stress in Soils:** Total stress, effective stress and neutral stress, capillary phenomenon, Quicksand phenomenon.

Self-Study Component (SSC): The Students shall explore the permeability of soil samples collected from different locations within the campus.

MODULE-3	**13 Hrs.**

Compaction of Soils: Definition, objectives of the compaction, compaction tests, dry density and moisture content relationships, factors affecting compaction. Effect of compaction on soil properties. Field compaction methods -Rollers and vibrators; Field compaction control - Procter's needle, nuclear density gauge

Compressibility of Soils: Concept of compressibility, Mass-spring analogy - Terzaghi's one dimensional consolidation theory - Assumptions, limitations and applications (Derivation and mathematical solution not required) – Normal, under and over consolidated soils, Pre-consolidation pressure, e-logp curve, compressibility index, coefficient of consolidation and their importance.

Self-Study Component (SSC): The Students shall visit work sites like roads, embankments and watch compaction methods, collect test details and prepare a report on the same.

MODULE-4	**12 Hrs.**

Shear Strength of Soil: Concept of shear strength - Mohr' s strength theory, Mohr - Coulomb theory. Shear strength tests under different drainage conditions. Shear strength parameters, factors affecting shear strength of soils.

Subsurface Exploration: Necessity of sub-soil exploration, Borings method of soil exploration. Types of samplers- undisturbed, disturbed and representative samples, area ratio, recovery ratio. Field tests such as SPT, vane shear, SCPT, identification of soils. Geophysical methods: Electrical resistivity, Seismic refraction methods.

Self-Study Component (SSC): The Students shall visit a work site and observe the different type of exploration and prepare the report.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Principles of Soil Mechanics and Foundation Engineering	Murthy, V.N.S.	5th Revised Ed.,	UBS Publishers and Distributors ltd, NewDelhi,	2001.
2	Soil Mechanics and Foundations	Punmia, B.C. Ashok Kumar Jain & Arun Kumar Jain	Revised	Laxmi Publishing Co., New Delhi.	2003.

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Foundation Analysis and Designs	Bowles, J.E,	5th Ed.	Mc Graw Hill Publishing, New York	2008
2	Geotechnical Engineering	Venkataramaiah,C.	Revised third Ed.,	New Age International publishers,	2006

EBooks and online course materials:

1. **NPTEL: Civil Engineering - NOC:Geotechnical Engineering - 1**

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1. Lab Component	20
Total		**50**

Laboratory Plan :

Lab Program	Program Details
1	Determination of moisture content, specific gravity & grain size analysis of soil sample.
2	Determination of in situ density of soil by core cutter and sand replacement methods.
3	Determination of Liquid limit of soil sample by Casagrandes and cone penetration method.
4	Determination of Plastic limit & Shrinkage limit of Soil sample.
5	Determination of compaction characteristics of soil by standard & modified Proctor test.
6	Determination of Shear strength parameters of soil by Direct shear Test.
7	Determination of shear strength parameters of soil sample by Tri axial shear test and unconfined compression test.

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	3	2		2									
CO2	3	2	2	1									
CO3	3	2	2	2									
CO4	3	2	2	1									

Course Title	TRANSPORTATION ENGINEERING		
Course Code	23CV504	(L-T-P)C	(3-0-2)4
Exam	3 Hrs	Hours/Week	05
SEE	100 marks	Total Hours	40+28

Course Objective: To learn broader understandings on various aspects of transportation engineering

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Conduct necessary field investigation for generation of required data for proposing new alignment or re-alignment of existing roads	PO1, PO2, PO3	–
2	Evaluate the engineering properties of the materials and suggest the suitability of the same for the pavement construction.	PO1, PO2, PO3	–
3	Design the thickness of pavement (Flexible and Rigid) and various pavement evaluation methods.	PO1, PO2, PO3	–
4	Evaluate the condition of highway drainage and associated problems and to evaluate the highway economics by various methods.	PO1, PO2, PO3	–

MODULE-1	10 Hrs.

Introduction: Importance of transportation – Comparison with all the modes – characteristics of road transportation – Jayakar committee recommendations and Implementation – 3rd and 4th Road development plans, numerical problems. Present scenario of road development in India Highway **Planning and Alignment:** Different road patterns – Planning surveys –Factors affecting highway alignment, Ideal requirements – Steps in New and Realignment. Phasing of road construction.

Self-study component:Students will visit to understand the impact of different patterns of road to know the advantages and disadvantages of the pattern in regard to traffic flow conditions.

MODULE-2	10 Hrs..

Highway Geometric Design (No Derivation) – Importance – Controlling factors –Design speedSurface characteristics – cross sectional elements-– camber — sight distances – Horizontal and vertical alignment. Pavement Materials and Construction: CBR and plate load tests – properties and requirements of Road aggregates – Bitumen – Types, construction procedures for subbase, base and

surface courses

Self-study component:Students will collect the data from State Highway department and design both horizontal and vertical geometrics and compare with existing geometrics

MODULE-3	**10 Hrs.**

Pavement Design: Design factors – Determination of ESWL, problem (Graphical method) – IRC method design of flexible pavement (IRC38-2012)- Stresses in rigid pavement – IRC method of design rigid pavement (IRC58-2015) (Excluding design of joints and problems on the above).

Self-study component:Students will visit ongoing project in and around Hassan city and to compare properties of materials analyzed with IRC specifications.

MODULE-4	**10 Hrs.**

Highway drainage: Surface drainage – types – functions, Sub surface drainage – Basic design principle. Highway Economics and financing: Highway user costs – VOC using charts – Highway costs – Economic analysis by Annual cost method – BCR method – Highway financing – BOT and BOOT concept

Self-study component:Students will visit different roads and identify important types of failures and list the suggestions to overcome the failure.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Highway Engineering	Khanna and Justo	10	Khanna publications New Delhi	2017
2	Highway Engineering	Kadiyali, L.R.	8	Khanna Publishers, New Delhi	

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Guidelines for the Design of Flexible Pavements	IRC	Code Book	IRC: 37-2012	2012
2	Guidelines for the Design of Rigid Pavements	IRC	Code book	IRC 58 - 2015	2015

EBooks and online course materials:

1. https://https://nptel.ac.in/courses/105107220

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1. Lab Component	20
Total		**50**

Laboratory Plan (if integrated course):

Lab Program	Program Details
1	Determination of specific gravity, sieve analysis on fine aggregate
2	Determination of specific gravity, sieve analysis on coarse aggregate
3	Determination of flakiness index & elongation index for coarse aggregate
4	Concrete mix design by IS code method as per 10262-2019 & 456-2000
5	Demonstration of strength of cement concrete cube at specified age
6	Demonstration of the strength/flexural strength of a cement concrete beam at a specified age.
7	Determination of specific gravity & penetration of bitumen.
8	Determination of ductility & softening point of bitumen.
9	Determination of flash and fire point & viscosity of bitumen.
10	Demonstration of Marshall stability test on bituminous material.

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	3	2	2										
CO2	3	2	2										
CO3	3	2	2										
CO4	3	2	2										

Course Title	ENVIRONMENTAL ENGINEERING LABORATORY		
Course Code	23CV505	**(L-T-P)C**	(0-0-2)1
Exam	3Hrs.	**Hours/Week**	02
SEE	50 marks	**Total Hours**	24

Course Objective: To familiarize students with standard procedures and techniques for the analysis of water and wastewater and to provide practical knowledge of sampling, preservation, and interpretation of environmental data

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

#	Course outcomes	Mapping to POs	Mapping to PSOs
1	Estimate the physical & general parameters concerning substances undesirable in excessive amounts for the suitability of water for drinking and construction purpose as per the specifications	PO1, PO4, PO6, PO8	
2	Estimate the parameters of wastewaters for its suitability to discharge the environmental pollutants as per specifications	PO1, PO4, PO6, PO8	

Sl NO.	Lab Exercises
1	Determination of Acidity
2	Determination of Alkalinity
3	Determination of Chlorides
4	Determination of Calcium, Magnesium and Total Hardness
5	Determination of Dissolved Oxygen
6	Determination of BOD
7	Determination of COD
8	Determination of percentage of available chlorine in bleaching powder, residual Chlorine and Chlorine Demand
9	Jar Test for Optimum Dosage of Alum – Turbidity determination by Nephelometer
10	Determination of Nitrates, Sulphates, iron and fluoride using Spectrophotometer
11	Determination of Solids in Sewage: Total Solids - Suspended Solids - Dissolved Solids - Volatile Solids - Fixed Solids – Settleable Solids.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Laboratory Manual for Environmental Engineering	N.N. Basak	2nd Edition	McGraw-Hill Education	2017
2	Environmental Engineering Laboratory Manual	M.R. Gidde	1st Edition	Laxmi Publications Pvt. Ltd.	2013
3	Standard Methods for the Examination of Water and Wastewater	APHA, AWWA, WEF	23rd Edition	APHA Press	2017

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Laboratory Manual for Environmental Chemistry	Sudha Goel	1st Edition	Cambridge University Press	2017
2	Environmental Engineering Laboratory Manual	Dr. S.K. Panigrahi, L. Mohanty	1st Edition	S.K. Kataria & Sons	2023

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	One CIEs conducted for 20 marks	20
Activity Details	Evaluation of Lab Record	30
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	1			3		2							
CO2	1			3		2							

Course Title	OCCUPATIONAL SAFETY AND HEALTH ASSESSMENT		
Course Code	23CV561	**(L-T-P)C**	(3-0-0)3
Exam	03 Hrs.	**Hours/Week**	03
SEE	100 marks	**Total Hours**	40

Course Objective: Students will be able to recognize and evaluate occupational safety and health hazards in the workplace, and to determine appropriate hazard controls following the hierarchy of controls

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

#	Course outcomes	Mapping to POs	Mapping to PSOs
1	Identify hazards in the workplace that pose a danger or threat to their safety or health and understand the laws governing OSHA	PO1, PO6,	
2	Analyze the standards and programs of ergonomics at workplace	PO1, PO6,	
3	Analyze the concept of fire accidents and its early detection and methods of extinguishing fire	PO1, PO6,	
4	Describe the role of health and safety in the workplace pertaining to the responsibilities of workers, managers and supervisors	PO1, PO6,	

MODULE-1	**10 Hrs.**

Occupational Hazard and Control Principles: Safety, History and development, National Safety Policy. Occupational safety and Health Act (OSHA), Occupational Health and Safety administration - Laws governing OSHA and right to know

Accident – Types of accidents, causation, investigation, investigation plan, Methods of acquiring accident facts, Supervisory role in accident investigation

Theories Of Accidents: Domino, Human Factor, Petersen's Accident incident, Epidemiological, Human Error Model and Combination theory.

Self Study Component: Compare the safety standards of two industries (e.g., construction vs. IT). Study real-life examples of hazard control methods like PPE, ventilation systems, lockout/tagout, etc.

MODULE-2	**10 Hrs.**

Ergonomics at Workplace: Ergonomics Task analysis, Preventing Ergonomic Hazards, Workspace Envelops, Visual Ergonomics, Ergonomic Standards and Ergonomic Programs.
Hazard cognition and Analysis: Human Error Analysis – Fault Tree Analysis – Emergency Response - Decision for action – purpose and considerations. Hazards and their Control in Pharmaceutical, construction, Textiles, Petroleum Refineries and LPG Bottling, Iron & Steel Industries.

Self Study Component: Prepare a report on major hazards and control measures in any two industry and Compare safety standards and preventive strategies across selected industries

MODULE-3	**10 Hrs.**

Fire Prevention and Protection: Fire Triangle, Fire Development and its severity, Effect of Enclosures, early detection of Fire, Classification of fire and Fire Extinguishers. Technical Requirements of safety - Electrical Safety and Product Safety

Health Considerations at Work Place: types of diseases and their spread, Health Emergency.

Self Study Component: Prepare a visual chart of fire classes vs. fire extinguishers.

MODULE-4	**10 Hrs.**

Personal Protective Equipment (PPE) – types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability
Occupational Health and Safety Considerations: Water and wastewater treatment plants, handling of chemical and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries. Policies, roles and responsibilities of workers, managers and supervisors

Self-Study: students shall visit nearby industry and study the policy and regulations followed by the respective industry and make a report on safety precautions adopted by the industry

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Occupational Safety and Health for Technologists, Engineers, and Managers	David L. Goetsch	8th Edition	Pearson Education	2019
2	Safety and Health for Engineers	Roger L. Brauer	3rd Edition	Wiley-Interscience	2016

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Fundamentals of Occupational Safety and Health	Mark A. Friend, James P. Kohn	6th Edition	Government Institutes / Bernan Press	2018
2	Handbook of Occupational Safety and Health	Danuta Koradecka (Ed.)	2nd Edition	CRC Press / Taylor & Francis	2010

EBooks and online course materials:

1. https://libraryguides.mcgill.ca/c.php?g=360379&p=2433815

Online Courses and Video Lectures:

1. **Industrial Safety and Fire Safety Management. Dr. P.K.Ghosh & Mrs.Annapurna Adiley, Chhattisgarh Swami Vivekanand Technical University (CSVTU), Bhilai**

https://onlinecourses.swayam2.ac.in/nou24_ge81/preview

2. **Industrial Safety Engineering By Prof. Jhareswar Maiti | IIT Kharagpur**

https://onlinecourses.nptel.ac.in/noc24_mg110/preview

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1. Group Activity - Field visit and report submission 2. Quiz	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	2					3							
CO2	3					2							
CO3	2					3							
CO4	3					2							

Course Title	REMOTE SENSING AND GIS		
Course Code	23CV562	**(L-T-P) C**	(3-0-0)3
Exam	03 Hrs.	**Hours/Week**	03
SEE	50 marks	**Total Hours**	40

Course Objective: To develop Knowledge on RS and GIS technologies to collect analyze and interpret spatial data for solving real life problems

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

#	Course outcomes	Mapping to POs	Mapping to PSOs
1	Comprehending remote sensing entails understanding of Energy interactions	PO1,P02	
2	Applying remote sensing in data collection and analysis through different types of sensors & platforms	PO1,P02	
3	Comprehend GIS : Managing , Analyzing ,Visualizing spatial data solutions	PO1,P02	
4	Develop a comprehensive report on different types of currently working satellites and their uses	P09, PO10	

MODULE-1	**10 Hrs.**

Introduction: Basics of Remote Sensing, Active and Passive Remote sensing (RS), Scope of remote sensing; Electromagnetic radiation and electromagnetic spectrum: Visible, Infra-Red (IR), Near IR, Middle IR, Thermal IR, and Microwave. Black body radiation and radiation laws; Interaction of EMR with atmosphere and Earth's surface features.

Types of Remote Sensing and Sensors Characteristics Platform and Orbits: Ground Based, Air Borne, Space borne. Orbits: Geo-Stationary satellite, Polar Orbiting satellite. Types & characteristics of sensors, Sensor resolution, Concept of Swath and Nadir,Remote sensing data products: IRS, LANDSAT, SPOT, IKONOS, Quick Bird

Self - study component: Students shall collect the information on space research organizational structure ,Types of Indian satellites, and data products

MODULE-2	**10 Hrs.**

Thermal Remote Sensing; Thermal properties of materials:
Emissivity of materials; thermal inertia of Earth surface features; Thermal data sets: LANDSAT and ASTER; Concept and Principles of microwave remote sensing; Microwave data sets SLAR, LIDAR and SAR;

Application of Thermal and Microwave data;
Digital Image processing: Introduction to Image, Digital image Types of Data Products, Types of image interpretation, Basic elements of image interpretation, Visual interpretation keys, Digital Image Processing, Preprocessing, image enhancement techniques, multispectral image classification, Supervised and unsupervised.

Self-study component: Students shall collect the information on commercial and open-source Remote Sensing data for use in GIS. Download free DEM and LULC data.

MODULE-3	**10 Hrs.**

Introduction to GIS:
Fundamentals of Geographic Information System: Basic Concepts: definition of GIS, Components of GIS, Variables - points, lines, polygon, Functionality of GIS, Recent trends and applications of GIS; GIS Softwares, Open-source GIS;

GIS Database: Geographic data: Spatial and non-spatial; Data models: Raster and vector; Database Management System (DBMS): Geo-database. Data Structures: Relational, hierarchical and network; Digitization of maps and imageries, Attribute data generation; Data Editing: Coordinate systems, Coordinate transformation. Reprojection.

Self-study component: Students shall collect the information on different commercial and open-source GISsoftware

MODULE-4	**10 Hrs.**

Integrated Applications of Remote sensing and GIS
Applications in land use land cover analysis , Change detection , Water resources , Urban planning, environmental planning, Natural resource management and Traffic Management , Location based services and its applications.
Introduction to Global Positioning System (GPS): GPS satellites constellations; GPS segments: Space, Control, User; GPS antennas, signals, and codes; GPS receivers; Modes of measurements and post processing of data; Accuracy of GPS measurements; Application of GPS.

Self-study component: Students shall collect the information on different GPS systems in the world and their working.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Remote Sensing and Image Interpretation	Lillesand, Kiefer, Chipman,	7th	Wiley	2022
2	Remote sensing and GIS	Basudeb Bhatta	3rd	Oxford university Press	2021
3	Geographical Information Science	Narayan Panigrah	1st	University Press	2009
4	Introduction to Geographic Information System	Kang – T surg Chang,	4th	Tata McGraw Hill Education Private Limited	2017

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Remote sensing and Geographical information system	Anji Reddy M.	2	B. S. Publications	2008
2	Basics of remote sensing & GIS	S Kumar,	1st edition	Laxmi publications	2016
3	Remote sensing of the environment	John R. Jensen,	2nd	Pearson Education	2013

EBooks and online course materials:

1. https://science.iirs.gov.in/wp-content/uploads/2024/09/Overview_of_Remote_Sensing_and_GIS_Applications_E-Book.pdf
2. https://www.gisresources.com/wp-content/uploads/2013/09/anji-reddy_GIS.pdf

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc22_ce84/preview
2. https://archive.nptel.ac.in/courses/105/103/105103193/
3. https://www.iirs.gov.in/pgdiploma

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1. Details of activity : **Analysis of Remote Sensing Data Sets**: Students explore and write about various types of remote sensing data sets (e.g., optical, microwave, thermal) and their applications, discussing the advantages and limitations of each. 2. Details of activity 2 : **GIS Theory and Case Study Presentation**: Students write a detailed case study on how GIS is used in real-world scenarios (e.g., environmental monitoring, urban planning) and present their findings	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	3	2											
CO2	3	2											
CO3	3	2											
CO4									3	2			

Course Title	GROUNDWATER DEVELOPMENT AND MANAGEMENT		
Course Code	23CV563	**(L-T-P)C**	(3-0-0)3
Exam	03 Hrs.	**Hours/Week**	03
SEE	100 marks	**Total Hours**	40

Course Objective: Learn basic fundamentals of groundwater flow, storage and yield. 2. Learn various methods of well development. The concepts of groundwater basin management, conjunctive use, competing demands, recharge and mining will add in equipping students to take better decisions in groundwater management.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Distinguish various aquifer properties to be used in the differential flow equations of the groundwater.	PO1	
2	Apply the knowledge to estimate various surface and subsurface investigations to be used in the groundwater explorations	PO1	
3	Analyze the various recharge methods and effective basin management	PO2	
4	Examine the various components of groundwater recharge methods through field visit and communicate and report the need for and importance of them	PO6, PO11	

MODULE-1	**10 Hrs.**

Groundwater Occurrence and Movement: Groundwater hydrologic cycle, origin of groundwater, zone of aeration and zone of saturation, geologic formation as Aquifers, types of aquifers, porosity, Specific yield and Specific retention. Percolation, Permeability, Darcy's law, storage coefficient, Transmissivity, differential equation governing groundwater flow in three dimensions - derivation, Line of Saturation, Phreatic Surface and Phreatic line.

Self-study component:Groundwater Flow Contours and their applications

MODULE-2	**10 Hrs.**

Surface And Subsurface Investigation:Surface methods of exploration – Electrical resistivity and Seismic refraction methods. Subsurface methods – Geophysical logging and resistivity logging. Aerial Photogrammetry applications

Self-study component:Case studies in Subsurface Investigation

MODULE-3	**10 Hrs.**

Artificial Recharge Of Groundwater: Concept of groundwater recharge – recharge methods, relative merits, Applications of GIS and Remote Sensing in Recharge of Groundwater along with Case studies.

Self-study component: Case Studies on Artificial Recharge of Groundwater

MODULE-4	**10 Hrs.**

Groundwater Basin Management: Groundwater basin management concept, hydrologic equilibrium equation, groundwater basin investigations, data collection & fieldwork, dynamic equilibrium in natural aquifers, management potential & safe yield of aquifers, stream-aquifer interaction

Self-study component: Explore the concept of conjunctive use and its implications for water resource management.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Groundwater Hydrology	David Keith Todd and Larry W. Mays	3rd Edition,	JOHN WIELY	2004
2	Ground Water	H. M. Raghunath	3rd Edition,	New Age International Publications	2007

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Groundwater Hydrology	B.R.Chahar	8th Edition,	McGraw Hill Education,	2015
2	Groundwater System Planning & Management	R.Willes&W.W.G.Yeh	Revised	Prentice Hall of India,	2001

EBooks and online course materials:

1. https://link.springer.com/book/10.1007/978-3-319-75115-3

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc22_ce44/preview

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1. Examine the various components of groundwater recharge methods through field visit and communicate and report the need for and importance of them	20
Total		**50**

Course Articulation Matrix

Course Outcomes	**Program Outcomes**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	2												
CO2	3												
CO3		3											
CO4						2					2		

Course Title	REPAIR AND REHABILITATION OF STRUCTURES		
Course Code	23CV564	**(L-T-P)C**	(3-0-0)3
Exam	03 Hrs	**Hours/Week**	03
SEE	100 marks	**Total Hours**	40

Course Objective:

1. Investigate the cause of deterioration of concrete structures.
2. Strategies different repair and rehabilitation of structures

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Identify the causes for structural (Concrete) deterioration	PO1	
2	Analyze the type and extent of damage and carry out damage assessment of structures through various types of tests	PO2	
3	Analyze the maintenance requirements of the buildings and preventive measures against influencing factors.	PO2	
4	Prepare a comprehensive report on deterioration of structural elements of the building	PO8, PO9	

MODULE-1	**10 Hrs.**

Introduction: Definition of Repair, Retrofitting, and rehabilitation. Physical and Chemical Causes of deterioration of concrete structures, Evaluation of structural damages to the concrete structural elements due to earthquake and natural disaster. Diagnostic devices for investigation and distress assessment. Special Mortars and concrete.Protective Coatings, Epoxy Bonding Agents

Self-study component: Students have to visit rehabilitation site and submit a report

MODULE-2	**10 Hrs..**

Damage Assessment: Purpose of assessment, Rapid assessment, Investigation of damage, Evaluation of surface and structural cracks, Damage assessment procedure, destructive, nondestructive and semi destructive testing methods.. Pullout Test, Carbonation , Chloride Penetration test .

Self-study component: Students have to visit concrete lab and perform NDT on sample specimen

MODULE-3	**10 Hrs..**

Maintenance and Retrofitting Techniques: Definitions: Maintenance, Factors affecting Maintenance and importance of Maintenance Need for retrofitting, retrofitting of structural members i.e., column and beams by Jacketing technique, Externally bonding(ERB) technique, near surface mounted (NSM) technique, External post- tensioning, guidelines for seismic retrofitting of existing building.

Self-study component: Students have to collect information of jacketing technique in retrofitting

MODULE-4	**10 Hrs.**

Materials for Repair and Retrofitting: Artificial fiber reinforced polymer like CFRP, GFRP, AFRP and natural fiber like Sisal and Jute. Adhesive like, Epoxy Resin, Special concretes and mortars, concrete chemicals, special elements for accelerated strength gain, Techniques for Repair: Rust eliminators and polymers coating for rebar during repair foamed concrete, dry pack mortar and concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning.

Self study component : Students have to visit site to visualize artificial FRPS and submit a report

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Concrete Structures Repair Rehabilitation	BHATTACHARJEE J	1st Edition	CBS	2019
2	Repair and Rehabilitation of Structures and Retrofitting	Dr R N Krishna (Author), Prof. A R Santhakumar	1st edition	STANDARD BOOK HOUSE SINCE 1960	2022

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Repair of Concrete Structures	R.T.Allen and S.C. Edwards	1st edition	-Blakie and Sons	2019
2	Learning from Failure in the Design Process Experimenting with Materials	Lisa Huang	1st Edition	Taylor & Francis	2020

EBooks and online course materials:

1. **https://theconstructor.org/wp-content/uploads/2016/09/handbook-rrs.pdf**
2. **https://www.scribd.com/document/625159318/Repair-and-Rehabilitation-of-Concrete-Structures-by-Dr-b-Vidivelli**

Online Courses and Video Lectures:

1. https://nptel.ac.in/courses/105106202
2. https://nptel.ac.in/courses/archive.nptel.ac.in/courses/105/105/105105213/

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1.Examine the various components of a building under failure through field visit and communicate and report the need for repair and retrofitting. 2. Regular short quizzes conducted for each module for understanding of the most recent concepts.	20
Total		**50**

Course Articulation Matrix

Course Outcomes	**Program Outcomes**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	3												
CO2		2											
CO3		3											
CO4								3	2				

Course Title	STABILITY ANALYSIS OF SLOPES AND DEEP EXCAVATION		
Course Code	23CV565	**(L-T-P)C**	(3-0-0)3
Exam	03 Hrs	**Hours/Week**	03
SEE	100 marks	**Total Hours**	40

Course Objective: To equip students with the knowledge and skills to assess the stability of slopes and to design safe and reliable structures.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Classify slope failures and explain failure mechanisms using geological data	PO1, PO2	
2	Analyze seepage and slope stability using analytical and graphical methods	PO1, PO5	
3	Assess rock slope failures and recommend suitable stabilization techniques.	PO2, PO3	
4	Conduct site-based or model-based investigations and present technical findings.	PO4, PO10	

MODULE-1	**10 Hrs.**

Introduction: Introduction, classification of natural slopes and excavation failures, slope stability – mechanics of slope failure, failure modes. Collection and analysis of geological data, field survey and testing, graphical presentation of geological data and evaluation of potential slope problems.

Self study component: Student shall visit any site investigate the natural slopes and prepare a report on it.

MODULE-2	**10 Hrs.**

Seepage analysis: in-situ permeability tests, two dimensional flow – Laplace equation and it's solution, graphical method, determination of phreatic line, flow nets in homogeneous and zoned earth dams. Soil slopes, infinite slope, method of slices, friction circle methods etc., Bishop's modified method, Bishop's rigorous method, Janbu's method, Morgenstern and Price, Spencer's method, stability analysis of dam body during steady seepage.

Self study component: Student shall develop a numerical model for seepage analysis of Gorur dam Hassan

MODULE-3	10 Hrs.

Rock slopes: methods of slope stability analysis, plane failure, wedge failure, over toppling failure, Hoek & Bray's charts, three dimensional wedge analysis seismic considerations, computer programs, use of non-linear failure criterion in rock slope stability analysis.

Strengthening & stabilization of slopes: Strengthening measures, stabilization of slopes by drainage methods, surface and subsurface drainage, use of synthetic filters, retaining walls, stabilization and strengthening of slopes, shotcreting, rock bolting and rock anchoring.

Self study component: Student shall design & develop reinforcement for rock slopes near.

MODULE-4	10 Hrs.

Deep Excavation: Introduction to the analysis and design of excavations - Geological investigation and soil tests, Conditions of the adjacent properties, Confirmation of the conditions of an excavation site, Designing criteria, Excavation analyses, Protection of neighboring properties

Excavation methods and lateral supporting system: Introduction, Excavation methods like full open cut methods, Braced, anchored, island Methods, sheet piles, column piles, diaphragm walls, strutting system.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Geotechnical Slope Analysis	Chowdhary Robin and Chowdhary Indrajit	2nd Edition	CRC Press.	31 December 2023
2.	Rock Slope Engineering	Hoek, E. and Bray, J.W.,	4th Edition	CRC Press.	2005
3	Deep Excavation Theory and Practice	Chang-Yu Ou		Taylor & Francis.	

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Software for Engineering Control of Landslides and Tunneling Hazards	Singh, B. and Goel, R.K.,	1st Edition	A A Balkema Publishers	1 January 2002

2.	Rock Slope Engineering	Wyllie Duncan C and Christofer W Mah,	4th edition	Spon Press	2004

EBooks and online course materials:

1. Rock Slope Engineering
2. ROCK SLOPE STABILITY ANALYSIS

Online Courses and Video Lectures:

1. Slope Engineering
2. Soil Mechanics/Geotechnical Engineering I

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1. Presentation - 10Marks 2. Site visit and report on it - 10Marks	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	2	3											
CO2	2	3											
CO3			3										
CO4			2	3									

Course Title	ENVIRONMENTAL IMPACT ASSESSMENT		
Course Code	23CV566	**(L-T-P)C**	(3-0-0) 3
Exam	03 Hrs.	**Hours/Week**	03
SEE	100 marks	**Total Hours**	40

Course Objective:
To provide comprehensive understanding of the principles, methodologies, and practices involved in assessing the environmental consequences of proposed projects or policies.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Discuss on conceptual framework and principles of EIA	PO1, PO6, PO7	
2	Acquire proficiency in various methodologies, techniques, and tools used in conducting EIA	PO1, PO6, PO7	
3	Comprehend strategies for effective stakeholder engagement and consultation throughout the EIA process	PO1, PO6, PO7	
4	Recognize the ethical considerations and professional responsibilities associated with conducting EIAs	PO1, PO6, PO7	

MODULE-1	10 Hrs.

EIA: Definitions, Purpose of EIA, Scope of EIA, Hierarchy in ElA. EIA as practiced in India and other countries. MOEF guidelines on siting of industries. Framework of Impact assessment. Relationship between EIA,EIS and Fonsi

The EIA process, Contents of EIA, EIS, FONSI. Environmental Management Plan (EMP) and Disaster Management Plan (DMP).

Self-study component: Download the document of a EIA Case Studies and Best Practices, submit a report

MODULE-2	10 Hrs.

Methodologies & Techniques in EIA: Adhoc, checklist, matrix (attribute activity relationship), overlays, networks, BEES, Techniques in EIA –brainstorming, fuzzy, CBA, Delphi technique, EIA Models.

Self-study component: Download the document of an Environmental Monitoring and Assessment,

submit a report.	
MODULE-3	**10 Hrs.**
Environmental Attributes: Air, water, land, sound, Socio economic aspects and biodiversity. Standards and Value functions-Graphs and interpretations-Impact significance. **Public participation in EIA:** Need, objectives, elements and framework for public participation – step by step procedure. ***Self-study component: Download the document of a Case Studies and Practical Applications, submit a report.***	
MODULE-4	**10 Hrs.**
EIA audit–Types and auditing procedure, Detailed EIA for Red category industries Pharmaceuticals, Power Plants, Mining, Pulp and paper mills, distilleries. Construction Projects, Airports, MRTS, MSW/HSW projects. Water and Wastewater Treatment facilities, mega desalination projects. ***Self-study component: Students shall visit Industries and study the Quality Assurance and Quality Control (QA/QC), submit a report.***	

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Environmental Impact Assessment	Anjaneyulu and Valli Manickam	2nd	BS Publications	2010
2	Environmental Impact Assessment	V S Kulkarni, S N Paul	Revised	Scientific publisher	2019

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Environmental Impact Assessment	Larry Canter	2nd	Mc Graw Hill Publishers	2007
2	Environmental Impact Assessment	Judith Petts	Revised	Blackwell Science	2010

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc22_ar07/preview

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1. Group Activity 2. Quiz	20
Total		**50**

Course Articulation Matrix

Course Outcomes	**Program Outcomes**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	3					2	2						
CO2	3					2	2						
CO3	3					2	2						
CO4	3					2	2						

Course Title	RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS		
Course Code	23RIP	**(L-T-P)C**	(3-0-0) 3
Exam	3 Hrs.	**Hours/Week**	03
SEE	100 Marks	**Total Hours**	40

Course Objective: To give an overview of technical research activities and patenting methodology.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Carry out Literature Review and write technical paper	PO2, PO3, PO4, PO8, PO12	
2	Describe the fundamentals of patent laws and the patent drafting procedure	PO6, PO8, PO10,PO12	
3	Elucidate the copyright laws and subject matters of copyright	PO6, PO8, PO10, PO12	

MODULE-1	**10 Hrs.**

Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research.

Ethics in Engineering Research: Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward, Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading.

MODULE-2	**10 Hrs.**

Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, acknowledgments and Attributions.

Technical Writing and Publishing: Free Writing and Mining for Ideas, Attributes and Reasons of Technical Writing, Patent or Technical Paper?—The Choice, Writing, Journal Paper: Structure and Approach: Title, Abstract, and Introduction, Methods, Results, and Discussions, Table, Figures, Acknowledgments, and Closures

MODULE-3	**10 Hrs.**

Introduction To Intellectual Property: Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP, Major Amendments in IP Laws and Acts in India.

Patents: Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. NonPatentable Matters. Patent Infringements.

Process of Patenting: Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. Do I Need First to File a Patent in India. Patent Related Forms. Fee Structure. Types of Patent Applications.

MODULE-4	**10 Hrs.**

Copyrights and Related Rights:

Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC).

Trademarks: Eligibility Criteria. Who Can Apply for a Trademark. Acts and Laws. Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration.

Self-study:Case Studies on Patents. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, IP Organizations In India.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Engineering Research Methodology	Dipankar Deb, Rajeeb Dey, Valentina E, Balas.	1st	Springer	2019
2	Intellectual Property	Prof. Rupinder Tewari, Ms. Mamta Bhardwa	1st	Professor Gurpal Singh Sandhu Honorary Director, Publication Bureau, Panjab University	2021

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Research Methods for Engineers	David V. Thiel	1st	Cambridge University Press	2014
2	Intellectual Property Rights	N.K.Acharya	8th Edition	Asia Law House,	2021

EBooks and online course materials:

1. **https://onlinecourses.swayam2.ac.in/ntr24_ed08/preview**

Online Courses and Video Lectures:

4. **https://youtu.be/E2gGF1rburw**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1. 2.	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**	
CO1		3	2	3				2				3		
CO2						3		2		3		3		
CO3						3		2		3		3		

Course Title	ENVIRONMENTAL STUDIES		
Course Code	23EVS	**(L-T-P)C**	(1-0-0) 1
Exam	03 Hrs.	**Hours/Week**	01
SEE	100 marks	**Total Hours**	14

Course Objective:

1. To create environmental awareness among the students.
2. To gain knowledge on different types of pollution in the environment

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

#	Course Outcomes	Mapping to PO'	Mapping to PSO's
1	Acquire an awareness of sensitivity to the total environment and its allied problems.	PO7, PO9	
2	Develop strong feelings of concern, sense of ethical responsibility for the environment and the motivation to act in protecting and improving it	PO6, PO8	
3	Analyze and evaluate environmental measures in real world situations in terms of ecological, political, economical, societal and aesthetic factors.	PO6, PO7, PO8, PO9	

MODULE-1	**04 Hrs.**

Environment: Definition, Ecosystem, Balanced ecosystem, Effects of human activities on environment Agriculture Housing Industry Mining and Transportation.

MODULE-2	**03 Hrs.**

Natural Resources: Water resources, Availability and Quality, Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources - Forest Resources - Material Cycles - Carbon, Nitrogen and Sulphur Cycles.

MODULE-3	**03 Hrs.**

Pollution: Effects of pollution - Water pollution - Air pollution Land pollution - Noise pollution.

MODULE-4	**04 Hrs.**

Current Environmental issues of importance: Acid Rain, Ozone layer depletion - Population Growth, Climate change and Global warming. Environmental Impact Assessment and Sustainable Development Environmental Protection - Legal aspects. Water Act and Air Act.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Environmental Studies	Dr. D.L Manjunath	1st	Dorling Kindersley	2006
2	Environmental Studies	Dr. S. M. Prakash	3rd	Elite Publishers	2006

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Environmental Studies	Benny Joseph	3rd	Tata McGraw Hill	2017
2	Principles of Environmental Science and Engineering	P. Venugopala Rao	Revised	Prentice Hall of India	2012

EBooks and online course materials:

1. **https://www.ebookselibrary.com/book-detail/higher-education/arts/Environmental-Studies-1159**

Online Courses and Video Lectures:

1. https://onlinecourses.swayam2.ac.in/cec19_bt03/preview
2. https://onlinecourses.nptel.ac.in/noc23_hs155/preview

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	2 CIEs conducted for 25 marks each	50
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1							3		3				
CO2						3		3					
CO3						3	3	3	2				

Course Title	DESIGN AND DETAILING OF RC STRUCTURES		
Course Code	23CV601	**(L-T-P)C**	(3 - 0 - 2) 4
Exam	3 Hrs	**Hours/Week**	3
SEE	100 Marks	**Total Hours**	68 (40L+28P)

Course Objective: To understand and gain knowledge to build a structure that can effectively withstand the internal loads and meet the requirements.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Limit state philosophy related to flexure, shear, bond, torsion and analysis of singly and doubly reinforced rectangular sections, as per the provisions of IS 456- 2000 in limit state of flexure	PO1, PO2	-
2	Examine the mechanism of RC sections in the limit state of serviceability in deflection and cracking and design of beams as per IS:456-2000	PO2, PO3	-
3	Design the limit state of compression members – short columns and also design of slabs as per IS:456-2000	PO2, PO3	-
4	Design the various types of footings and staircase as per IS:456- 2000	PO3, PO6	-

MODULE-1	**10 Hrs.**

General Features of Reinforced Concrete- Introduction–Design loads–Materials for reinforced concrete –Code requirements for concrete reinforcements –Elastic theory of RC section –Moment of resistance of sections –Balanced, under reinforced and over reinforced sections.

Principles of Limit State Design and Ultimate Strength RC Section – Philosophy of limit state design – Concept of limit states – Factor of safety – Characteristic and design loads – Characteristic and design strength–General aspects of ultimate strength–Stress block parameters for limit state of collapse. Limit state of flexural strength of singly and doubly reinforced rectangular sections. Limit state of flexural strength of flanged sections. Limit state of shear strength of RC sections. Concepts of bond, development length and anchorage–Examples on analysis of rectangular and flanged RC sections.Durability requirements, minimum Grade of concrete for design as per IS:456, reinforcement cover requirements and detailing.

Self-study component: Students shall visit ongoing construction project sites to observe the casting of RC components.

MODULE-2	10 Hrs.

Serviceability Limit State – General and durability aspects–Deflection limits in IS: 456-2000 – calculation of deflection (Theoretical method) – Cracking in structural concrete members- Calculation of deflections and crack width as per IS:456-2000.

Design of Beams – Practical requirements of an RCC beam – size of the beam – Cover to the reinforcement – Spacing of bars – Design procedure – Critical sections for moments and shear – Anchorage of bars: check for development length –Reinforcement requirements –Slenderness limits for beams to ensure lateral stability – Design examples for simply supported beams and cantilever beams-singly and doubly reinforced.

Self-study component: Students shall visit an ongoing construction project site to observe the design and detailing of RC beam.

MODULE-3	10 Hrs.

Design of Slabs – Introduction – General consideration of design of slabs –deflection criteria-rectangular slabs spanning in one direction – Rectangular slabs spanning in two directions for various boundary conditions – Design of simply supported slabs – cantilever slabs and continuous slabs- one way and two-way. **Design of Columns** – General aspects –restraints and boundary conditions-Effective length – Loads on columns – Slenderness limits for columns – Minimum eccentricity – Design of short axially loaded columns – Design of column subjected to combined axial load and uniaxial moment using SP16.

Self-study component: Students shall visit an ongoing construction project site to observe the design and detailing of RC slabs and columns.

MODULE-4	10 Hrs.

Design of Footings – Introduction – Load on foundation –Design of isolated rectangular footing for axial load, eccentric, uniaxial moment–Design of pedestal. **Design of Stair Case** –General features – Types of Staircases–Loads on staircases –Effective span as per IS 456-2000.–Distribution of loading on stairs–Design of dog-legged staircases.

Self-study component: Students shall visit an ongoing construction project site to observe detailing of RC footing and staircase.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Design of Reinforced Concrete Structures	Krishna Raju N	2011	CBS Publishers and Distributors	2011
2	Limit State Design of Reinforced Concrete	Varghese P.C	2008	Laxmi Publications	2013

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Reinforced Concrete Design	Ashok Kumar Jain and Arun Kumar Jain	10th	Lakshmi Publications	2018
2	Reinforced Concrete Design	S.Unnikrishna Pillai	4th	TMH	2021

Online Courses and Video Lectures:

1. https://archive.nptel.ac.in/courses/105/105/105105105

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Two activities will be conducted	20
Total		**50**

Laboratory Plan (if integrated course):

Lab Program	Program Details
1	SinglyReinforcedBeamsC/S DoublyReinforcedBeam C/S (NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above beams using drafting software) **7 Hrs**
2	Singly Reinforced Beams L/S and C/S Doubly Reinforced Beam L/S and C/S Flanged Beam L/S and C/S. Beams–Simply supported, Cantilever and Continuous. (NOTE: Drawings to be prepared for given structural details. Also bar bending schedule should be prepared for above beams) **7 Hrs**
3	Slab–One way,Two way and One way continuous slab Column(Square and Rectangular). (NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above drawings) **7 Hrs**

4	Column footing- Column and footing (Square and Rectangle). Staircase–Dog legged and open well staircase (NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above drawings) **7 Hrs**

Course Articulation Matrix

Course Outcomes	**Program Outcomes**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1		**3**	**2**										
CO2		**3**				**2**							
CO3	**3**		**2**			**2**							
CO4		**3**											

Course Title	IRRIGATION ENGINEERING AND HYDRAULIC STRUCTURES		
Course Code	23CV602	**(L-T-P)C**	(3-0-0)3
Exam	3 Hrs.	**Hours/Week**	3
SEE	100 marks	**Total Hours**	40

Course Objective: To provide comprehensive understanding of Design of Hydraulic structures forms an integral part of water resources engineering projects.

Course Outcomes: At the end of the course the student will be able to

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Comprehend the knowledge on irrigation engineering and check the stability of different components of hydraulic structures	PO1	PSO1
2	Apply the principles to estimate irrigation requirements and quantity of seepage through hydraulic structures	PO1	PSO1
3	Analyze the behavior of hydraulic structures under different forces	PO2	PSO1
4	Examine the various components of hydraulic structures through field visit and communicate and report the need and importance of them	PO6, PO9,	PSO2

MODULE-1	10 Hrs.

Introduction to Irrigation: Definition, necessity of irrigation, Sources of water: surface and groundwater, System of irrigation: flow irrigation, lift irrigation, Bandhara irrigation.

Water Requirements of Crops: Duty, delta and base period, relationship between them, factors affecting duty of water crops and crop seasons in India, irrigation efficiency, frequency of irrigation.

Self-study component : Benefits and ill effects of irrigation

MODULE-2	10 Hrs.

Irrigation Structures: Canals: Types of canals. Alignment of canals. Definition of gross command area, cultural command area, intensity of irrigation, time factor, crop factor. Unlined and lined canals.

Standard sections. Design of canals by Lacey's and Kennedy's method (Simple Numerical Problems).

Self-study component : Economical height of dam.

MODULE-3	10 Hrs.
Gravity Dams: Introduction, forces acting on dam, cause of failure, design principles, Elementary and practical profile of a gravity dam, Stability analysis (without earthquake forces) **Earth Dams**: Introduction, types, factors governing selection of dam, causes of failure of earth dams, preliminary design criteria, Determination of phreatic line. Estimation of seepage loss. ***Self-study component: Characteristics of seepage line***	
MODULE-4	**10 Hrs.**
Spillways: Introduction, types, Design of Ogee spillway Diversion Headworks: Introduction, types, Design of aprons - Bligh's and Koshla's theory, Simple Problems on floor design. **Cross Drainage Works:** Introduction, Type, selection, Design considerations, Transition formula for design of protection works, Design of only aqueduct. ***Self-study component: Research the hydraulic performance of Ogee spillways under varying flow conditions.***	

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Irrigation Engineering and Hydraulic Structures	S. K. Garg,	38th Revised	Khanna Publishers	2023
2	Irrigation and Water Power Engineering	Punmia and PandeyLal	17th	Lakshmi Publications	2021

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Text Book of Irrigation Engineering and Hydraulic Structures	R. K. Sharma,	1st	Oxford and IBH,	2016
2	Irrigation, Water Resources and Water Power	P. N. Modi,	9th	Standard Book House	2014

EBooks and online course materials:

1. https://archive.nptel.ac.in/courses/126/105/126105010/

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted 1. Examine the various components of hydraulic structures through field visit and communicate and report the need and importance of them	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**2**											**3**	
CO2	**3**											**3**	
CO3		**3**										**3**	
CO4						**2**			**2**				**3**

Course Title	APPLIED GEOTECHNICAL ENGINEERING		
Course Code	23CV603	**(L-T-P)C**	(3-0-0) 3
Exam	3 Hrs.	**Hours/Week**	3
SEE	100 Marks	**Total Hours**	40

Course Objective: Apply soil mechanics principles to design and analyze foundations, evaluate soil stability, and solve geotechnical engineering problems.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Analyze retaining wall by computing the lateral earth pressure for active and passive cases and stability of earth slope in the construction of canals, road embankments and earthen dams.	PO1, PO2, PO4	
2	Evaluate the vertical stress under the loaded area using the concept of stress distribution in soil	PO2, PO4	
3	Analyze the bearing capacity of different variety of soils subjected to different types of loading conditions and field methods for suitability of different types of foundations and ground conditions	PO1, PO2, PO4	
4	Apply the concept of ground improvement techniques for different types of foundation soils	PO1, PO2, PO4	

MODULE-1	**10 Hrs.**

Earth Pressure: Active & Passive earth pressure, earth pressure at rest, earth pressure coefficient and their range. Rankine's theory of earth pressure – Assumptions and limitations. Lateral earth pressure in cohesive and cohesionless soil.

Stability of Earth Slopes: Types of slopes, Causes and types of failure of slopes. Definition of factor of safety. Stability of finite and infinite slopes - Method of slices, Friction circle method, Fellineous method. Taylor's stability number.

Self-study component: Students shall visit the site and study the overview of the site conditions and know the different parts of the structures like retaining walls, highway or railway embankments and earthen dams etc.

MODULE-2	**10 Hrs..**

Stresses in Soil: Boussinesq's and Westergaard's theories for concentrated, circular load, rectangular loads, strip load. Pressure bulb (Isobar) concept. Newmark's chart.

Bearing Capacity: Definitions of ultimate, net and safe bearing capacities. Allowable bearing pressure. Rankine's, and Terzaghi's analysis, Assumptions and limitations of Terzaghi's bearing capacity. Types of failures. Brinch Hansen's bearing capacity equation. Effect of groundwater table on bearing

capacity of soil.

Self study component: Students shall visit the site and study the ground conditions and types of soils. They shall obtain the soil samples from field and conduct the laboratory tests and calculate the safe bearing capacity of soil and submit the report.

MODULE-3	**10 Hrs..**

Bearing Capacity from Field Tests: Plate-load test: Procedure, limitations of plate load tests use of N values for calculating bearing capacity and allowable soil pressure, Static and Dynamic cone penetration test.

Shallow Foundations: Definition of foundation, General types of foundation, types of shallow foundation, settlement of foundation – concept and types - immediate, consolidation and secondary settlements (No derivations).

Self-study component: Students shall visit the site and study the ground conditions and assess the suitability of different types of foundations for different types of soil conditions.

MODULE-4	**10 Hrs.**

Pile Foundations: Necessity of pile foundations, classification of pile foundations, different types of piles and their advantages and limitations. Simple methods of estimating bearing capacity of piles – Dynamic formulae, static formulae, and pile load test. Negative skin friction.

Introduction to Ground Improvement Techniques - Importance, methods - vibrofloatation, stone column, blasting, compaction piles, cement grout, thermal treatment and electro-osmosis.

Self-study component: Students shall visit the site and study the site conditions and collect the geological information. Also, they shall apply the knowledge to adopting different techniques for different types soil for ground improvement technique.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Geotechnical Engineering	Venkataramaiah C	Revised third Ed	New Age International publishers,	2006
2	Soil Mechanics and Foundations	Punmia, B.C. Ashok Kumar Jain &Arun Kumar Jain		Laxmi Publishing Co	2003

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	FoundationAnalysis andDesigns	Bowles,I.E	5thEd	McGrawHill Publishing	1996

2	Principles of Soil Mechanics and Foundation Engineering	Murthy, V.N.S	5th Revised Ed	UBS Publishers and Distributors ltd	2001

EBooks and online course materials:

https://archive.nptel.ac.in/courses/105/105/105105185/
https://onlinecourses.nptel.ac.in/noc22_ce96/preview

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted Details of activity 1 Details of activity 2	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	3			2									
CO2		3		2									
CO3	3	2		2									
CO4	3	2		1									

Course Title	MAJOR PROJECT PHASE - I		
Course Code	23PROJ1	**(L-T-P)C**	(0-0-4)2
Exam	3 Hrs.	**Hours/Week**	4
SEE	100 Marks	**Total Hours**	50

Course Objective: To involve in team work to demonstrate the acquired skill & knowledge aimed to identify, formulate, analyze, evaluate and to provide meaningful engineering solutions to industrial/ societal needs.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Identify a problem from the available literature and societal needs	PO2, PO4	
2	Apply principles of Civil Engineering in designing and conducting experiments, data acquisition and interpretation towards meaningful analysis of identified problem	PO2, PO4, PO5, PSO1	
3	Use analytical, teamwork and leadership skills in designing and development of products or find solution to the identified problem	PO4, PO5, PO6, PO7, PO8, PO9, PSO2	
4	Prepare a detailed project report and present the work using appropriate presentation tools	PO9,PO10,PO12, PSO2	

PHASE – 1 (PART 1)	**20 Hrs.**

Duration of two weeks between VII and VIII semesters. Candidates in consultation with the guides shall carry out literature survey / visit premier institutions/laboratory/ industry to finalize the topic of the project. Evaluation of the project and its feasibility is evaluated in the concerned department in the beginning of the VIII semester.

PHASE – 2 (PART 2)	**20 Hrs..**

Eight weeks duration during the VIII semester students are expected to finalized the project work and indicate intermediate results, design carried out/ algorithms developed must be validated.

The evaluation follows the below-mentioned scheme:

Sl. No.	Criteria	CIE
1	Organization	20
2	Content	20
3	Subject knowledge	20
4	Presentation	20
5	Communication and Time Management	20
	TOTAL	**100**

Final project report should have the following contents:
1. Introduction – Showing the relevance of the subject in the present context /motivation
2. Literature Review
3. Objectives and scope of the Project
4. Materials and Methodology

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1		**3**		**3**									
CO2		**3**		**3**	**3**							**3**	
CO3				**3**	**3**	**3**	**3**	**3**	**3**				**3**
CO4									**3**	**3**			**3**

Course Title	THEORY OF ELASTICITY		
Course Code	23CV651	(L-T-P)C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
SEE	100 Marks	Total Hours	40

Course Objective: To impart knowledge of mathematical techniques for analyzing the structures
Course Outcomes: At the end of course, student will be able to,

CO's	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Formulate the differential equations of equilibrium and boundary conditions, mathematical representation of stresses and strains at a point.	PO1,PO2, PO3	
2	Analyze strains, strain rosettes, compatibility equation	PO1,PO2, PO3	
3	Formulate Airy's stress function, 2D problems in rectangular coordinates under different loading conditions.	PO1,PO2, PO3	
4	Analyze the basic equations of elasticity in the polar coordinate system the stress distribution under axi-symmetric loading in thick discs	PO1,PO2, PO3	

MODULE-1	10 Hrs.

Introduction to Mathematical theory of elasticity – Definition of Continuum – Stress and strain at a point – Constitutive laws – Generalized Hooke's law – Strain - displacement relations. Analysis of Stress: Introduction – differential equations of equilibrium – Boundary conditions – Principal stresses and principal Planes –Mohr's Circle.

MODULE-2	10 Hrs..

Analysis of Strain: Introduction –Plane stress and Plane strain–Principal planes–measurement of surface strains – Strain rossetes – Compatibility concept – need and physical significance – Compatibility equation in terms of strains.

MODULE-3	10 Hrs..

Two-dimensional Problems in Rectangular Coordinates –compatibility equations for plane stress and plane strain cases – Airy's stress function – Polynomial stress functions. Bending of a cantilever beam subjected to end load and u.d.l – Simply supported beam subjected to UDL – Displacements in Cantilever and S.S.Beams

MODULE-4	10 Hrs.

Two dimensional problems in polar coordinates: Strain-displacement relations – Equations of equilibrium–Compatibility equation–Stress-function. Axi symmetric problems–Thick discs and cylinders – Rotating discs and cylinders. Effect of Circular Holes on Stress Distribution in Plates- Subjected to Tension, compression and shear – Stress concentration factor.

Self- study component: Students shall revise differential calculus and the significance of differential equations, Hooke's Law, elastic constants, stress and strain relations stress - strain relations, beam bending theory, bending stresses from basic strength of materials

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Theory of Elasticity	Timoshenko S.P and Goodier J.N	2007	Tata Mc Graw- Hil	2015
2.	Theory of Elasticity	Sadhu Singh	2007	Khanna Publishers	2015

Online Courses and Video Lectures:

1. https://archive.nptel.ac.in/courses/105/105/105105177/

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted Details of activity 1 Details of activity 2	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**2**	**3**		**1**									
CO2	**2**	**3**		**1**									
CO3	**2**	**3**		**1**									
CO4	**2**	**3**		**1**									

Course Title	Structural Dynamics		
Course Code	23CV652	**(L-T-P)C**	(3-0-0)3
Exam	3 Hrs	**Hours/Week**	3
SEE	100 Marks	**Total Hours**	40

Course Objective: To analyze SDOF and MDOF for undamped and damped structures for free and forced vibration.

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

#	Course outcomes	Mapping to Pos
1	Comprehend principles of vibration and elementary components of a vibratory system, analyze undamped and damped free vibration of a single degree of freedom system	PO1, PO2, PO3
2	Analyze undamped and damped forced vibration of a single degree of freedom system	PO2, PO3, PO4
3	Comprehend the response of SDOF to general system of loading	PO2, PO3, PO4, PO5
4	Analyze MDOF systems	PO2, PO3, PO4, PO5

MODULE-1	**11 Hrs.**

Introduction; Laws of motion, D' Alembert's Principle, Stiffness of springs in series and parallel, Mas inertia, Simple harmonic motion, Definition of vibration – Parts of a vibrating system –Degrees of free of vibration. Free vibration; Undamped and damped free vibration of a single degree system–Logarithmic decrement.

Self-study component: Students shall collect material from the internet on fundamentals of dynamics and free vibration, prepare a report and submit

MODULE-2	**11 Hrs..**

Forced Vibration; Undamped and damped forced vibration of a single degree of freedom system – Steady state response, Dynamic magnification factor, response to harmonic loading. Forced vibration (cont'd); Rotational and reciprocating unbalance, Force transmissibility, Force transferred to the foundation.

Self-study component: Self-study component: Students shall collect material from the internet on forced vibration and its effect on machine foundation. Prepare a report and submit.

MODULE-3	10 Hrs..
SDOF subjected to base excitation; Harmonic base excitation, Vibration isolation, Vibration measuring instruments. Response of SDOF for general System of loading (undamped); Duhamel' Integral – dynamic load factor for step, rectangular, ramp and triangular input ***Self-study component: Self-study component: Students shall collect material from the internet on fundamentals of vibration isolation, vibration measuring instruments and response of a SDOF system. prepare a report and submit***	
MODULE-4	**10 Hrs.**
MDOF Systems: Free vibration – natural frequencies – Orthogonality principle. Eigen values and Eigen vectors, Shear buildings modeled as MDOF systems. MDOF Systems (Cont'd); Forced undamped and damped vibration of shear buildings – Modal superposition method – Response to harmonic excitation only. ***Self-study component: Students shall observe the demonstration of vibration of MDOF system, and collect material from the internet on fundamentals of MDOF systems subjected to both forced undamped and damped vibrations. prepare a report and submit***	

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Vibrations, Dynamics and Structural Systems	Mukhopadhya, M	Ane's Student	Oxford IBH Publications	2000
2	Structural Dynamics	Mario Paz	5th	CBS Publishers	2004

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Dynamics of Structures	Clough & Penzien	2nd	McGraw Hill Publisher	2015
2	Dynamics of structures: Theory and applications to earthquake engineering.	Chopra, A. K.	5th	Prentice Hall, NJ, USA	2020

Online Courses and Video Lectures:

1. https://archive.nptel.ac.in/courses/105/106/105106151/
2. https://archive.nptel.ac.in/courses/105/101/105101006/
3. https://onlinecourses.nptel.ac.in/noc24_ce74/preview
4. https://archive.nptel.ac.in/courses/105/104/105104189/

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted 1)Assignment 2) Group Activity	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**1**	**3**	**2**										
CO2		**3**	**2**	**1**									
CO3		**3**	**2**	**1**	**1**								
CO4		**3**	**2**	**1**	**1**								

Course Title	TRAFFIC ENGINEERING		
Course Code	23CV653	**(L-T-P)C**	(3-0-0)3
Exam	3 Hrs.	**Hours/Week**	03
SEE	100 Marks	**Total Hours**	40

Course Objective: To learn broader understandings on various aspects of traffic engineering.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Identify the characteristics of traffic engineering & to evaluate the feasibility of road by using traffic volume studies & speed studies	PO1, PO2, PO3	
2	Categorize the road based on LOS and to judge road safety by analyzing accident studies.	PO1, PO2	
3	Evaluate the arrival pattern of vehicles by traffic flow theories and to develop statistical techniques for minimizing congestion.	PO1, PO2, PO3	
4	Propose suitable traffic regulation methods, design relevant signals and rotary and to develop a theme of green traffic	PO1, PO3	

MODULE-1	**10 Hrs.**

Scope of Traffic Engineering: Objectives and scope of traffic engineering, components of road traffic - the vehicle, driver and road, road user characteristics – factors governing, vehicular characteristics, power performance of the vehicle, concepts of passenger car units for mixed traffic flow. Traffic Engineering Studies and Analysis: Sampling in Traffic Studies, methods of traffic study, equipment, data collection, analysis and interpretation of (i) Spot speed (ii) Speed and delay (iii) Volume (iv) Origin - Destination (v) Parking studies.

Self-study component: Students shall visit the local Traffic control office and discuss the traffic problems and vehicular characteristics and shall calculate the instantaneous speed of the vehicle.

MODULE-2	**10 Hrs..**

Traffic capacity studies: Basic capacity, Possible capacity, Practical capacity, LOS concept, Factors affecting capacity & LOS, Capacity of multilane rural highways, urban streets & signalised intersections. Crash Studies: Objectives – causes – records – preparation of accident report – Condition diagram – Collision diagram – Accident investigations. Analysis of individual traffic accidents – Analysis of speed from skid resistance – Collision of moving vehicle with parked vehicle – Two vehicles approaching at right angles collide–Numerical examples, Measures for reduction in accident rates.

Self-study component: Students shall collect information on traffic volume, traffic density, causes of accidents, and measures for reduction of accidents from the local traffic control office.	
MODULE-3	**10 Hrs..**
Traffic Flow Theories: Definition – relationship between speed, flow and concentration – Fundamental diagram of traffic flow, Queuing theory – applications, assumptions - Arrival pattern – service facility characteristics, numerical examples, Traffic simulation. Statistical Analysis: Importance, various statistical methods - Regression methods, Poisson distribution, use of chi – squared test, numerical examples on these methods. ***Self-study component: Students shall study the applications of different probability distributions to traffic problems.***	
MODULE-4	**10 Hrs.**
Traffic Regulation and Control: Measures to meet the problems, Vehicle, Driver and Road Control – Traffic Regulation – Traffic signs, Traffic Signals – advantages, types, Principles of signal design – methods. Trial cycle method, Webster method and IRC method with numerical examples, Traffic rotary intersection, design guidelines with numerical examples. ITS in Urban Traffic: Intelligent Transport System, Necessities, Application in the present traffic scenario. ***Self-study component: Students shall visit a traffic junction and observe the working of signals during different times of a day and shall study emerging technologies in urban traffic.***	

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Traffic Engineering and Transport Planning"	Kadiyali, L. R	10	Khanna Publishers	2019
2	Highway Engineering	Khanna, S. K, Justo, C. E. G, and Veeraragavan A.	8	Nem Chand and Bros, Roorkee	2019

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Fundamentals of Transportation Engineering	Papacostas, C.A	5	Prentice-Hall of India Pvt. Ltd., New Delhi	2001
2	Introduction to Traffic Engineering	Kumar, R. S	6	University Press	2019

EBooks and online course materials:

https://https://onlinecourses.nptel.ac.in/noc24_ce80/preview

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted Details of activity 1 - Students shall carryout the activity as mentioned in the self study component and submit a report. Details of activity 2 - Quiz and Assignment	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**3**	**2**	**1**										
CO2	**3**	**2**											
CO3	**3**	**2**	**1**										
CO4	**3**		**1**										

Course Title	RURAL WATER SUPPLY & SANITATION		
Course Code	23CV654	**(L-T-P)C**	(3-0-0)3
Exam	3 hrs	**Hours/Week**	3
SEE	100 Marks	**Total Hours**	40

Course Objective: To provide knowledge on technical aspects of drinking water supply and scope of sanitation in rural areas

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

#	Course Outcomes	Mapping to POs	Mapping to PSOs
1	Discuss the importance of village community and need for protected water supply	PO1, PO6	-
2	Describe the need and methods of water treatment and rural sanitation	PO1, PO6	-
3	Assess different methods of rainwater harvesting and refuse disposal	PO1, PO6	-
4	Discuss various methods of controlling communicable diseases and milk sanitation	PO1, PO6	-

MODULE-1	**10 Hrs.**

Introduction: Importance of Village community in India, Need for protected water supply, Traditional sources of water in rural areas, Investigation and selection of water sources

Rural Water Supply: Waterborne diseases, protection of well waters, drinking water quality standards, Water lifting arrangements, Water supply system

Self Study Component: Explore methods of investigating and selecting water sources, including: Site selection, Water table considerations and Quality and quantity assessment.

MODULE-2	**10 Hrs..**

Water Treatment Methods: Disinfection, Defluoridation, Hardness and iron removal, water quality surveillance, groundwater contamination and control

Improved methods and compact systems of treatment: Brief Details of multi-bottom settlers (MBS), diatomaceous earth filter, cloth filter, slow sand filter, chlorine diffusion cartridges. Water supply during fair, festival and emergencies.

Rain Water Harvesting: need, advantages, components of roof top rain water harvesting system, methods of rainwater harvesting, maintenance tip for rainwater harvesting structure

Self Study Component: Visit a local or online water treatment project and summarize the treatment method used.

MODULE-3	10 Hrs..
Rural Sanitation: Disposal of night soil, requirement of privy, types of privies, disposal by trenching and composting, Imhoff tank, septic tank, soak pit, Sullage and storm water disposal **Refuse Collection & Disposal:** Types and characteristics of refuse, refuse collection – planning and collection system. Refuse disposal – dumping, hog feeding, methods of composting, methods of sanitary land filling. Dung disposal and biogas plant for dung disposal ***Self Study Component: Study a case example of rural sanitation success (e.g., Swachh Bharat Abhiyan village case study)***	
MODULE-4	**10 Hrs.**
Communicable Diseases and Insect Control: Terminology, classification, modes of communication, general methods of control. House fly and mosquito - life cycle, disease transmission and control measures **Milk Sanitation:** Essential of milk sanitation, Essential tests for milk quality, methods of pasteurization, cattle borne disease and planning for a cow shed. ***Self-study: Students shall visit nearby villages and study different sanitation methods adopted and shall submit a report of their observations under self-study components.***	

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Rural Water Supply and Sanitation	Peter Harvey, Bob Reed	1st Edition	ITDG Publishing / Practical Action Publishing	2004
2	Rural Water Supply and Sanitation	Peter G. Bourne	1st Edition	Academic Press	1977

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Introduction to Potable Water Treatment Processes	Simon Parsons	1st Edition	Blackwell Publishing	2004

2	Appropriate Technologies for Rural Water Supply and Sanitation	R. Franceys, J. Pickford	1st Edition	WEDC, Loughborough University	1995

EBooks and online course materials:

https://www.eolss.net/ebooklib/sc_cart.aspx?File=E2-14-03-03

Online Courses and Video Lectures:

1. **Urban Utilities Planning: Water Supply, Sanitation and Drainage By Prof. Debapratim Pandit,IIT Kharagpur**

https://onlinecourses.nptel.ac.in/noc24_ar18/preview

2. **Wastewater Treatment and Recycling by Prof. Manoj Kumar Tiwari, IIT Kharagpur**

https://onlinecourses.nptel.ac.in/noc24_ce105/preview

Proposed Assessment Plan (for 50marks of CIE):

Tool	**Remarks**	**Marks**
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted 1. Group Activity - Field visit and report submission 2. Quiz	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**3**					**2**							
CO2	**2**					**3**							
CO3	**2**					**3**							
CO4	**3**					**2**							

Course Title	GROUNDWATER HYDRAULICS		
Course Code	23CV655	(L-T-P)C	(3-0-0)3
Exam	03 Hrs.	Hours/Week	03
SEE	100 marks	Total Hours	40

Course Objective: Understand the basics of groundwater including its properties, flow principles according to Darcy's Law, and aquifer characteristics such as types and parameters. Apply knowledge to analyze groundwater systems, including well hydraulics, contaminant transport, and management strategies for sustainability and remediation.

Course Outcomes: At the end of the course the student will be able to

#	Course outcomes	Mapping to POs
1	Comprehend the importance of groundwater resource management to develop and implement effective utilization, planning, and conservation strategies.	PO1
2	Apply the aquifer and flow characteristics to assess groundwater availability, movement and exploration.	PO1
3	Analyze aquifer recharge processes and groundwater utilization to develop knowledge of resource management.	PO2
4	Report on Ground water availability and Depletion in Hassan District, to analyze its impact on Environmental Sustainability through Recognizing the need for possible Recharge Techniques	PO6, PO9, PO11

MODULE-1	10 Hrs.

Introduction: Importance, Occurrence and Distribution of sub-surface water, Aquifer and its types, Aquifuge, Aquitard and Aquiclude.

Aquifer Properties: Specific yield (Laboratory and Field Methods), Specific retention, Porosity, Storage coefficient, Land Subsidence due to ground water withdrawals.

Self-Study Component: Students shall collect the ground water depletion information from the department of geology. Information from the observation well and their data of ground water level.

MODULE-2	10 Hrs.

Darcy's Law and Hydraulic Conductivity: Darcy's law, Hydraulic conductivity & Intrinsic permeability, Transmissibility, Permeability in Isotropic and Anisotropic layered soils.
Well Hydraulics – Steady Flow: Steady one-dimensional flow, Steady radial flow in confined and unconfined aquifers, Pumping tests.

Self-study component: Collect the information on the existing number of bore wells in Hassan districts & their classification on basis of ownership (government /private) and permission from the authority (with permission/without permission).

MODULE-3	10 Hrs..

Well Hydraulics – Unsteady Flow: Theis method, Cooper- Jacob method, Chow's method. Simple numerical problems.
Ground Water Development: Types of wells- Tube well design, Dug Wells, Method of constructions-working principles, Power & stages requirements, Sea water intrusion.

Self-study component: Students shall collect the information on types of ground water recharge structures. Information on existing recharges structure in Hassan District.

MODULE-4	10 Hrs.

Ground water Explorations: Seismic method, Electrical resistivity method, Borehole geophysical techniques- Electrical logging, Radio wave logging, Induction logging, Sonic logging and Fluid logging.
Ground water recharge and Runoff: Recharge by vertical leakage, Artificial recharge, Ground water runoff, Ground water budget.

Self-study component: Review on Watershed development, different policies, and schemes by government (public and private). Best examples at district level, State level and national level.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Ground Water	Raghunath H.M	4th Edition	New Age International Publishers	2008
2	Groundwater Hydrology	David K.Todd. Larry W.Mays	3rd Edition	Wiley India Pvt. Ltd, New Delhi.	2005

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Hydrology	Jaya Rami Reddy P	3rd Edition,	Laxmi Publications Pvt. Ltd. New Delhi.	2016
2	Numerical Groundwater Hydrology	Rastogi A. K	Revised	Penram International Publishing. (Ind) Pvt Ltd, Mumbai	2008

EBooks and online course materials:

1. **https://link.springer.com/book/10.1007/978-4-431-53959-9**

Online Courses and Video Lectures:

1. https://archive.nptel.ac.in/courses/105/105/105105042/

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted 1. Report on Ground water availability and Depletion in Hassan District, to analyze its impact on Environmental Sustainability through Recognizing the need for possible Recharge Techniques	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**2**												
CO2	**3**												
CO3		**3**											
CO4						**2**			**2**		**2**		

Course Title	MODERN CONSTRUCTION METHODS AND MECHANIZATION		
Course Code	23CV656	**(L-T-P)C**	(3-0-0) 3
Exam	3 Hrs.	**Hours/Week**	3
SEE	100 Marks	**Total Hours**	40

Course Objective:

1. To introduce the learner to the various types of equipment that are used in construction projects.
2. To impart knowledge about the application of these equipment for performing various construction activities in projects.

Course Outcomes: At the end of the course the student will be able to

CO's	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Apply various advanced construction techniques in sub structure and super structure of the building.	PO1	
2	Apply techniques and implementation of the paving technology in construction.	PO1	
3	Analyze contemporary issues pertaining to construction methods, equipment usage and management.	PO2	
4	Investigate and identify advanced construction methods and materials by visiting an active construction site.	PO6, PO9, PO10	

MODULE-1	10 Hrs.

Sub Structure Construction: Box jacking, pipe jacking – under pinning, trenchless technology, innovative road construction techniques; immerse tube tunnelling. Smart tunnels: application and construction

Self-study component:The students shall visit construction site to visualize box pushing and trenchless construction techniques and submit a report

MODULE-2	10 Hrs..

Super Structure Construction for Building: Vacuum dewatering of concrete flooring – concrete paving technology – techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – launching erection techniques of tall structures, large span structures – launching techniques for heavy decks –in situ prestressing in high rise structures, aerial transporting handling erecting lightweight components on tall structures

Self-study component: The students shall visit paving industries to understand the working of various machineries and submit a report .

MODULE-3	10 Hrs..
Construction of Special Structures: Erection of lattice towers and rigging of transmission line structures – construction sequence in cooling towers, silos, chimney, sky scrapers, bow string bridges, cable stayed bridges Advanced construction techniques for offshore structures – construction sequence and methods in domes & prestress domes – support structure for heavy equipment & conveyor & machinery in heavy industries – erection of articulated structures, braced domes & space decks ***Self-study component : Students shall collect the information on advanced construction techniques in India***	
MODULE-4	**10 Hrs.**
Form Works for Different Construction Techniques Introduction: Formwork and false work, Temporary work systems, Construction planning and site constraints, Materials and construction of the common formwork and false work systems, Special and proprietary forms., Types of beams, decking and column formwork, Design of decking, Falsework design, Effects of wind load, Foundation and soil on falsework design. Special Forms: The use and applications of special forms. Construction Sequence and Safety in use of Formwork: Sequence of construction, Safety use of formwork and falsework ***Self-study component : Students shall collect the information on types of formwork used in India***	

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Modern Methods of Construction and Innovative Materials	Arthur Lyons	(2nd ed.).	Routledge	2024
2	. "Construction Planning, Equipment, and Methods"	Peurifoy, R., Schexnayder, C., Shapira, A., & Schmitt, R.	(8th ed.).	McGraw-Hill.	(2011)

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	"Construction methods and management" .	Nunnally, S. W.	(8th ed.)	Prentice Hall.	(2011)

2	"Construction equipment management for engineers, estimators, and owners"	Gransberg, D. D., Popescu, C. M., & Ryan, R. C	(2nd ed.)	CRC Press.	(2006)

EBooks and online course materials:

1. **https://www.nhbc.co.uk/binaries/content/assets/nhbc/foundation/a-guide-to-modern-methods-of-construction.pdf**
2. **https://www.buildoffsite.com/content/uploads/2019/04/modern-methods-of-construction-paper-rics.pdf**

Online Courses and Video Lectures:

1. **https://onlinecourses.nptel.ac.in/noc21_ce21/preview**
2. **https://onlinecourses.swayam2.ac.in/nou25_ce05/preview**

Proposed Assessment Plan (for 50marks of CIE):

Tool	**Remarks**	**Marks**
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted activity 1: Examine the various modern techniques in construction sites through field visit and communicate and report activity 2 : Regular short quizzes conducted for each module for understanding of the most recent concepts.	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	3												
CO2	3												
CO3		3											
CO4						2			2	2			

Course Title	DESIGN OF BRIDGES AND FLYOVERS		
Course Code	23CV657	**(L-T-P)C**	(3-0-0) 3
Exam	3 Hrs.	**Hours/Week**	3
SEE	100 Marks	**Total Hours**	40

Course Objective:
To develop the ability to design safe, durable, and cost-effective bridges and flyovers that meet current and future traffic demands, minimize environmental impact, and comply with engineering standards through the application of structural principles and sustainable practices.

Course Outcomes: At the end of the course the student will be able to

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Acquire foundational knowledge of bridge structures, including their components, functions,, classifications and types of relevant IRC loads	PO1, PO11	
2	Analyze and compute the design discharge for a proposed bridge site using appropriate hydrological methods.	PO2, PO4	
3	Evaluate various types of abutments and piers, and calculate the forces acting on them under different loading conditions.	PO1, PO3	
4	Design slab culverts, pipe culverts, RC T-beam bridges, and steel-composite bridges as per IRC loading and design standards.	PO1, PO3	

MODULE-1	10 Hrs.

Introduction: Definition of a bridge - Components of a bridge and a flyover - Classification of bridges and flyovers - Requirements of an ideal bridge- Forces to be considered for the design of bridges and flyovers - IRC loading standards- Impact effect**.**

Hydraulic Design: Design discharge- Afflux, Natural waterway- Linear waterway -Economic span.

Self-study component: Students shall visit different types of bridges and flyovers and identify the various components, types of bridges, water way and number of spans etc., prepare a report and submit.

MODULE-2	10 Hrs..

Substructures: Abutments, Piers - Wing walls- Forces on substructures- Stability Considerations - Empirical design.

Foundations: Depth of foundation – Pile and well foundation - Depth of scour**.**

Self-study component: Students shall visit a typical bridge construction site and identify the substructures and type of foundation, prepare a report and submit.

MODULE-3	10 Hrs..

RC Slab Culverts: Design of superstructure for IRC class AA loading (Tracked Vehicle and Wheel Loading).

Pipe Culverts: Design for both shallow and deep embankment for IRC class AA wheel loading.

Self-study component: Students shall visit a typical slab culvert and pipe culvert construction sites and identify various components, prepare a report and submit. They shall also observe the type of vehicular loading on the Culverts.

MODULE-4	10 Hrs.

RC T Beam Bridge: Design of slab by using Pigeaud's curves- Design of longitudinal girders by Morice Little method for IRC class AA or 70R loading. **Composite Bridge:** Design of RC slab and steel girder for equivalent loading- Design of shear connectors. **Flyovers:** Introduction, Advantages and disadvantages, types of flyover bridges, simple flyover design.
Self-study component: Students shall visit a typical RC T Beam Bridge and composite bridge and identify the components and, prepare a report and submit. They shall also observe the type of vehicular loading on the above- mentioned bridges.

Prescribed Text Books:

Sl.No.	Book Title	Authors	Edition	Publisher	Year
1	Essentials of Bridge Engineering	Jhonson Victor	6th	Oxford IBH Publication	2019
2	Principles and Practice of Bridge Engineering	Bindra S.P	5th	Dhanapat Rai Publications	1996

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year

	Design of Bridges	Krishna Raju N		Oxford IBHPublication	
2	Design of Bridge Structure	Jagadeesh, T. R. & Jayaram, M. A.		II Edn. PHI Learning Pvt.Ltd.	
3	Standard Specifications and Code of Practice for Road Bridges	IRC: 6	6th	Indian Roads Congress	2017
4	Standard Specifications and Code of Practice for Road Bridges, Section III: Cement Concrete (Plain and Reinforced)	IRC: 21	3rd	Indian Roads Congress	2000

EBooks and online course materials:

1. **Microsoft PowerPoint - 5. Shri P G Venkat Ram- Bridge Construction methods and the failures associated with them**
2. **Analysis and Design of Flyover Bridge**

Online Courses and Video Lectures:

1. **Conceptual Planning of Bridges | Coursera**
2. **NPTEL :: Civil Engineering - NOC:Bridge Engineering**

Proposed Assessment Plan (for 50marks of CIE):

Tool	**Remarks**	**Marks**
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted 1) To observe, analyze, and document different types of bridges based on location, structure, material, and function, and correlate them with theoretical knowledge. 2) Regular short quizzes conducted for each module for understanding of the most recent concepts.	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**3**										2		
CO2		**3**		**2**									
CO3	**2**		**3**										
CO4	**2**		**3**										

Course Title	WATER SUPPLY AND SANITATION		
Course Code	23OECV661	**(L-T-P) C**	(3-0-0)3
Exam	3 Hours	**Hours/Week**	3 Hrs
SEE	100 Marks	**Total Hours**	40

Course Objective: Prepare students to contribute to planning, implementation, and maintenance of water and sanitation systems in real-world community settings

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Estimate average and peak water demand for a community.	PO1, PO2	-
2	Evaluate water quality and plan suitable treatment system	PO1, PO6	-
3	Discuss various treatment methods available for treating drinking water	PO1, PO6	-
4	Evaluate wastewater quality and design suitable conveyance systems for sewage and design a comprehensive wastewater treatment system	PO1, PO6	PSO1

MODULE-1	10 Hrs.

Introduction: Need for protected water supply, Factors affecting water supply scheme and benefits. **Demand Of Water**: Types of water demands - domestic demand, institutional and commercial, public uses, fire demand. Factors affecting per-capita demand, variations in demand of water, Peak factor, Design periods and factors governing the design period. Different methods of Population forecasting. **Sources**: Concept of hydrological cycle, Surface and subsurface sources - suitability with regard to quality and quantity. Factors governing the selection of a particular source of water.

Self Study Component: Forecast the future population and design water supply scheme for hassan city

MODULE-2	10 Hrs.

Quality of Water: Concept of safe water: wholesomeness, palatability and potability. Physico Chemical characteristics (Drinking water standards: BIS & WHO standards). Numerical problems on pH and MPN
Collection and Conveyance of Water: Intake structures - different types of intakes; factors for the selection and location of intakes. **Pumps** - Necessity, types and factors for the selection of a pump
Water Treatment: Objectives and Treatment flowchart – significance of each unit. **Aeration** – Principle, aerators.
Self Study Component: Visit nearby intake structure and submit a detailed report on it

MODULE-3	10 Hrs.

Sedimentation: Theory, settling tanks and types. **Filtration:** Mechanism - theory of filtration, types of filters- slow sand, rapid sand and pressure filters **Disinfection**: Definition, Requirements, methods of disinfection. **Softening**: Definition, methods of removal of hardness by lime soda-process and zeolite process with merits and demerits **Water Conservation** – Rain Water Harvesting.

Self study Component: Students shall visit nearby water treatment plants and study various treatment techniques adopted and shall submit a report of their observations

MODULE-4	**10 Hrs.**

Wastewater: Wastewater disposal - Necessity for sanitation, types of sewerage systems and their suitability. Quantification of sewage and estimation of storm water flow. **Sewer**: Sewer pipe materials, Shapes of sewers, laying of sewers, jointing and testing of sewers, ventilation and cleaning of sewer. **Sewer Appurtenances:** Catch basins, Manholes, Flushing tanks, oil and grease traps, Drainage traps, Basic principles of house drainage, typical layout plan showing house drainage connections

Self Study Component: Students shall visit the nearby Industry and observe the methods adopted for sewage treatment and disposal. The students shall submit a report of their observations under self-study components.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Environmental Engineering: Volume I – Water Supply Engineering	Santosh Kumar Garg	28	Khanna Publisher	2022
2	Environmental Engineering – Vol. II: Sewage Disposal and Air Pollution Engineering	S.K. Garg	29th Edition	Khanna Publishers	2022

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Water and Wastewater Technology	Mark J. Hammer & Mark J. Hammer Jr.	VII	Pearson Education	2012
2	Wastewater Engineering: Treatment and Resource Recovery	Metcalf & Eddy, George Tchobanoglous, H. David Stensel	5th Edition	McGraw-Hill Education	2014

EBooks and online course materials:

1. **https://www.google.co.in/books/edition/Water_and_Wastewater_Engineering/evcEQgAACAAJ?hl=en**
2. https://www.google.co.in/books/edition/Water_Supply_Engineering/74HYY31zwhQC?hl=en&gbpv=0

Online Courses and Video Lectures:

1. Wastewater Treatment and Recycling by Prof. Manoj Kumar Tiwari, IIT Kharagpur https://onlinecourses.nptel.ac.in/noc24_ce105/preview
2. Urban Utilities Planning: Water Supply, Sanitation and Drainage By Prof. Debapratim Pandit,IIT Kharagpur **https://onlinecourses.nptel.ac.in/noc24_ar18/preview**

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1. Group activity - field visit and report submission 2. Quiz	20
Total		**50**

Course Articulation Matrix

Course Outcomes	**Program Outcomes**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**2**	**3**											
CO2	**2**						**3**						
CO3	**2**						**3**						
CO4	**3**						**2**						**3**

Course Title	COMPOSITES & SMART MATERIALS		
Course Code	23OECV662	(L-T-P)C	(3 - 0 - 3) 3
Exam	03 Hours	Hours/Week	03
SEE	50 Marks	Total Hours	40

Course Objective: To enable students to understand the behavior, analysis, and applications of composite and smart materials.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Comprehend the basic properties and mechanical behavior of composite materials in different directions	PO1	
2	Apply laminate theory and micromechanical models to study single and multi-layer composite materials behavior and its failures	PO1	
3	Analyze the role of smart materials like sensors and actuators in enhancing structural performance	PO2	
4	Analyze smart, sustainable materials to address industry-specific problems, and work in teams to evaluate their performance and communicate their practical benefits	PO6, PO8 PO9	

MODULE-1	10 Hrs.

Introduction to Composites materials: Classifications and applications of fibers, matrix and Composite materials, Weight and Volume fraction and load distribution among constituents, minimum & critical volume fraction, Compliance & Stiffness matrices.

Self-Study component: Students shall gain knowledge about the innovative composite materials and their applications in the Civil engineering domain.

MODULE-2	9 Hrs..

Anisotropic elasticity - Unidirectional and anisotropic lamina, thermo- mechanical properties, micromechanical analysis, classical composite lamination theory.Cross and angle–ply laminates, symmetric, antisymmetric and general asymmetric laminates, mechanical coupling and laminate stacking.

Self-Study component: Students shall explore appropriate websites to observe the behaviour of composite material subject to varying temperature.

MODULE-3	10 Hrs..
Analysis of simple laminated structural elements - Ply-stress and strain, lamina failure theories - first fly failure, environmental effects and manufacturing of composites-Hand layup technique, Pressure bag and Vacuum bag technique, Resin transfer moulding, Injection Moulding and Pultrusion. ***Self-Study component: Students shall learn different types of composite materials and their application in aircraft design***.	
MODULE-4	**10 Hrs.**
Smart materials - Introduction, Types of smart structures, actuators & sensors, embedded & surface mounted actuators and sensors, piezoelectric coefficients, phase transition, piezoelectric constitutive relation. ***Self-Study component: Students shall learn about self-healing materials used in the aircraft industry etc..***	

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Analysis and Performance of Fiber Composites	Bhagwan D. Agarwal, Lawrence J. Broutman, K. Chandrashekhara	4th	John Willy and Sons	2017
2	Mechanic of Composite Materials	Robart M Jones	2nd	McGraw Hill Publishing Co.	1999

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	An Introduction to Composite Principles of Composite Material MechanicsMaterials	Clyne, T. W., & Hull, D.	2nd	Cambridge University Press	2019
2	Principles of Composite Material Mechanics	Gibson, R. F.	4th	CRC Press	2016
3	Analysis and Performance of Fiber Composites	Agarwal, B. D., Broutman, L. J., & Chandrashekhara, K.	3rd	Wiley India	2006

EBooks and online course materials:

1. https://www.academia.edu/93600895/Smart_Structures_Theory
2. https://dokumen.pub/composite-materials-science-and-engineering-4th-ed-2019-978-3-030-28982-9-978-3-030-28983-6.html?utm_source=chatgpt.com

Online Courses and Video Lectures:

1. https://archive.nptel.ac.in/courses/105/108/105108124/
2. https://nptel.ac.in/courses/112104173

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted Work in a team to choose a smart material and explain how it can be used to solve a problem in a specific industry (like automobiles, space, medical, or construction). Describe how it works, why it's better than regular materials, and what benefits it offers.	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	3												
CO2	3												
CO3		3											
CO4						2		2	2				

Course Title	HAZARDOUS WASTE MANAGEMENT		
Course Code	23OECV663	(L-T-P)C	(3-0-0) 3
Exam	3Hrs	Hours/Week	3
SEE	100 Marks	Total Hours	40

Course Objective: Foster critical thinking, problem-solving, and ethical decision-making skills necessary for addressing the complex challenges and ethical dilemmas associated with hazardous waste engineering and environmental protection.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Summarize the fundamentals of hazardous waste, relevant regulations, and the magnitude of the problem because of its improper management	PO1, PO2	
2	Explain various physical, chemical & biological methods of treating hazardous wastes and remediation of polluted sites	PO1, PO2	
3	Estimate the concentrations of hazardous pollutants in different phases & engineering design of treatment units and disposal facilities	PO1, PO2	
4	Assess risks for toxic substances and their adverse effects on living organisms, environment and human health	PO1, PO6	

MODULE-1	11 Hrs.

Fundamentals of Hazardous Waste Management- Definition of hazardous waste, properties and characteristics of hazardous wastes, past waste management practices, Partitioning coefficients, Conceptual Site Model, Source – Pathway – Receptor Analyses. Environmental legislations for hazardous waste disposal and land transport.

Self-study component: Students shall have a deeper understanding of hazardous waste management principles and practices.

MODULE-2	10 Hrs..

Risk Assessment and Waste Handling- Concept of risk and hazard, exposure pathway, calculation of risk, hazard identification, toxicity assessment, carcinogenic effects and non- carcinogenic effects, exposure assessment, applications of risk assessment, and Uncertainties. Waste minimization – factors & case studies, Solutions to major problems associated with hazardous wastes

Self-study component: students shall understand the risk assessment and waste handling.

MODULE-3	11 Hrs..

Treatment of Hazardous Wastes- Physico – chemical treatment - Stabilization, Sorption, Volatilization – Air stripping, Soil Vapor Extraction, Advanced Oxidation Process, Permeable Reactive Barrier Biological treatment - Difference between biological treatment of solid waste with hazardous waste, Composting, Bioremediation – growth kinetics, inhibition, in situ and ex situ bioremediation - Reductive dehalogenation, Bioreactors, and Constructed Wetlands ***Self-study component: students shall know different advanced treatment methods to reduce the toxic waste.***
MODULE-4 **10 Hrs.**
Storage & Disposal of Hazardous Wastes- Treatment, Storage and Disposal Facilities (TSDFs) - Facility Design & Operation - Hazardous waste landfills – landfill design parameters, Landfill gases and leachate generation, Air strippers – operating requirements and their design aspects, Incinerators - types of devices, operating & regulatory requirements and their design aspects ***Self-study component: students shall gain insights into current practices and emerging trends in hazardous waste storage and disposal.***

Prescribed Text Books:

Sl. No	Book Title	Authors	Edition	Publisher	Year
1.	Waste Management Practices: Municipal, Hazardous, and Industrial.	Pichtel, J.	second	CRC Press	2014
2.	Hazardous Waste Management.	La Grega, M. D., Buckingham, P. L., & Evans, J. C.	Third	Waveland Press.	2010

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Handbook on Chemicals and Hazardous waste manageWaste Management and Handling in India.	Bhat, S	fifth	School of India University ,Bengaluru	. (2019).

2.	.Hazardous and Other Wastes (Management & Transboundary Movement) Rules. (2016).	Govt of India	first	Ministry of Environment, Forests & Climate Change, New Delhi.	2016

EBooks and online course materials:

https:NPTEL Syllabus - Solid & Hazardous Waste Management

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted 1) Details of activity 1 2) Details of activity 2	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO 2**
CO1	**3**	**2**											
CO2	**3**	**2**											
CO3	**3**	**2**											
CO4	**3**					**2**							

Course Title	SUSTAINABILITY IN ENGINEERING SYSTEMS		
Course Code	23OECV664	(L-T-P) C	(3-0-0)3
Exam	3 hours	Hours/Week	3
SEE	100 Marks	Total Hours	40

Course Objective:

1. Learn about the principles, indicators and general concept of sustainability.
2. Student shall be able to apply the sustainability concepts in engineering

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

#	Course Outcomes	Mapping of POs	Mapping of PSOs
1	Interpret the sustainability concepts; understand the role and responsibility of engineers in sustainable development.	PO1,PO2	
2	Utilize scientific approach to quantify and rationalize sustainability and resource availability.	PO1,PO2	
3	Make use of sustainability concepts in construction practices, designs, product developments and processes across various engineering disciplines.	PO2,PO7	
4	Develop green engineering concepts and become a lifelong advocate of sustainability in society.	PO6,PO7	

MODULE-1	10 Hrs

Sustainability-Introduction, Need and impact, Glimpse into History-Millennium Development Goals and Sustainable Development Goals, Principles of Sustainable Development Goals, Current practices in SDG in Global and Indian perspective- Policy and programs.Environmental legislations in India-Related to Water and Air Act.

Self-study component: Sustainable development goals

MODULE-2	10 Hrs

Global Environmental Issue: Resource degradation, Climate change, Regional and Local Environmental Issues. Carbon credit and carbon trading, carbon footprint Carbon sequestration – Carbon capture and storage (CCS), CO2 calculation. Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking.

Self-study component: Risk assessment methods, LCA frameworks.

MODULE-3	10 Hrs

Sustainable design: Basic concepts of sustainable habitat, Green buildings,Passive solar design technique, Thermal storage, Cooling strategies, high performance insulation. Sustainable cities, Sustainable Transport.Industrial Processes: Material selection, Pollution Prevention, Industrial Ecology, Industrial symbiosis.

Energy sources: Basic concepts-Conventional and non-conventional, solar energy, Fuel cells,Wind energy, Small

hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy,Rainwater harvesting. ***Self-study component: Green economy, Community Solutions for Sustainable Development.***	
MODULE-4	**10 Hrs**
SDG Solutions: Implementing the SDGs Solutions and best practices at the individual, local, national, and international level, Measuring SDG success-Indicators, Monitoring, Evaluation, and Reporting,Challenges in implementing SDGs, Thinking beyond sustainability-Changing world-views and perspective through radical transformation. **AI & ML For sustainability:** Energy Efficiency-Smart Grids,Building Management Systems, Water Resource Management- Leak detection, demand forecasting, Sustainable Construction- Material optimization, Predictive maintenance, Climate Change Mitigation-Carbon Emission Monitoring, Environmental Impact Assessment ***Self-study component: Investigate successful state-level projects like Kerala's healthcare model and community-driven efforts such as the Sundarbans mangrove conservation project to learn about effective strategies for achieving SDGs***	

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	The Role of Agriculture and Small Farms in Economic Development, Washington	Hazell P. and Diao X	1st edition	International Food Policy Research Institute	2005
2	The End of Poverty: Economic Possibilities for Our Time	Sachs J	1st edition	Penguin	2006

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Sustainable Development for Engineers: A Handbook and Resource Guide	Karel Mulder	1st edition	Routledge	2006
2	Sustainable Design and Eco Technologies for Infrastructure: Select Proceedings of CECAR 9	Rajinder Ghai, Luh-Maan Chang, Raju Sharma, Anush K. Chandrappa	1st edition	Springer Nature	2024

EBooks and online course materials:

1. https://nptel.ac.in/courses/127105018
2. https://archive.nptel.ac.in/courses/109/106/109106200/

3. https://nptel.ac.in/courses/112104225
4. Urbanization in Western Ghats and Biodiesel: https://www.youtube.com/watch?v=uvSBN3nX2z0
5. Environmental sustainability **:** https://www.youtube.com/watch?v=Crd3CFq5B4s

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted Details of activity 1: Group activity on different environmental issues due to anthropogenic activity. Details of activity 2 : Group activity on case study related to Sustainable solutions around the world with presentation.	20
Total		**50**

Course Articulation Matrix

Course Outcomes	ProgramOutcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**3**	**2**				**2**							
CO2	**3**	**3**				**2**	**3**						
CO3		**2**				**2**							
CO4	**3**					**2**	**3**						

Course Title	RAILWAY ENGINEERING		
Course Code	23OECV665	**(L-T-P) C**	(3 - 0 - 0) 3
Exam	03 Hours	**Hours/Week**	03
SEE	100 Marks	**Total Hours**	40

Course Objective: The objective of this course is to provide students with a comprehensive understanding of the principles, construction, operation and maintenance of railway systems

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Illustrate the role of railways, comparing with other modes and highlight the initiatives by Indian railways towards tourism.	PO1, PO2	–
2	Explain the various key elements of a railway track, their types and methods of surveying.	PO1, PO2, PO3	–
3	Summarize the various methods of construction, types of gradients and superelevation concept.	PO1, PO2, PO3	–
4	Suggest the methods of maintenance of track, modernization concepts and methods of reducing railway expenses.	PO1, PO2	–

MODULE-1	**10 Hrs.**

Introduction: Role of railways in transportation, Classifications of modes, Comparison with other modes of transportation. Historical development of railways in India. Advantages of railways. Selection of routes-preliminary and locations surveys. Classifications of Indian Railway lines, Organization of Indian Railways & production units. Initiatives by Indian Railways for development of the tourism sector.
Self-study component: Students shall visit nearby Railway station, discuss with the staff regarding the zone of that particular station. Also, collect details on the number of trains operating, financial aspects, prepare a report and submit.

MODULE-2	**10 Hrs.**

Permanent way: Rail – functions, classifications and types. Sleepers – functions, classifications and requirements. Ballast – functions, requirements and types. Gauges – types. Cross section of permanent way, Coning of wheel, Creep of rail, Calculation of quantity of materials needed for laying of tracks.
Self-study component: Students shall visit nearby Railway station and observe the components of railway track, rail joints, sleepers and other details, prepare a report and submit.

MODULE-3	10 Hrs.

Modernization of Railways and High Speed Trains: Modernization of Railways, Effect of High-speed Track, Ballastless Track, Metro trains, High speed Vande Bharath Trains, Vistadome coaches, Tejas Rajadhani trains, SMART coaches, NMGHS coaches, Railway electrification.

Administration of Railways: Nationalization of railways, advantages & disadvantages. Zonal administration, Railway expenses, rates & fares: Characteristics, measures to reduce expenses & railway budget. Typical railway problems,

Self-study component: Students shall visit nearby Railway station and discuss with the railway staff regarding steps taken towards modernization, zonal administration, prepare a report and submit.

MODULE-4	10 Hrs.

Maintenance of track: Necessity, Advantages. Maintenance of Surface of Rails, track alignment, gauge, proper-drainage, track components, Bridge and its Approaches, Rolling stock, Points and Crossings, level crossings and tunnels. Signaling during maintenance work, Speed restrictions during maintenance work, special measures for maintenance of high speed track.

Safety in Railways: Railway accidents, Classifications, Causes and prevention, Duties of railway staff in serious accidents, Emergency methods of restoring railway traffic.

Self-study component: Students shall visit nearby Railway station and discuss with the railway staff regarding track maintenance, steps taken towards safety aspects, prepare a report and submit.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Railway Engineering	SC Saxena and Arora	10	Dhanpath Rai and Sons, New Delhi	2015
2	Indian RailwayTrack	M M Agarwal	9	Oxford Publications, Bombay	2018

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Principles of Railway Engineering	Rangawala	5	Charotar Publishing House, New Delhi	2017

2	Railway Engineering	Sathish Chandra	8	Oxford University	2013

EBooks and online course materials:

1. https://onlinecourses.nptel.ac.in/noc24_ce37/preview

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30
Activity Details	Details of activities to be conducted 1) Details of activity 1 - Students shall submit the report on self study component mentioned in each module. 2) Details of activity 2 - Quiz & Assignment	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**3**	**2**											
CO2	**3**	**2**											
CO3	**3**	**2**											
CO4	**3**	**2**											

Course Title	REMOTE SENSING AND GIS		
Course Code	23OECV666	(L-T-P)C	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
SEE	100 Marks	Total Hours	40

Course Objective: To develop Knowledge on RS and GIS technologies to collect, analyze and interpret spatial data for solving real life problems.

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

#	Course Outcomes	Mapping of POs	Mapping of PSOs
1	Comprehending remote sensing entails understanding of Energy interactions	PO1,PO2	
2	Applying remote sensing in data collection and analysis through different types of sensors & platforms.	PO1,PO2	
3	Comprehend GIS : Managing , Analyzing ,Visualizing spatial data solutions	PO1, PO2	
4	Develop a comprehensive report on different types of currently working satellites and their uses.	PO9, PO10	

MODULE-1	10 Hrs.

Introduction: Basics of Remote Sensing, Active and Passive Remote sensing (RS), Scope of remote sensing; Electromagnetic radiation and electromagnetic spectrum: Visible, Infra-Red (IR), Near IR, Middle IR, Thermal IR, and Microwave. Black body radiation and radiation laws; Interaction of EMR with atmosphere and Earth's surface features;

Types of Remote Sensing and Sensors Characteristics Platform and Orbits: Ground Based, Air Borne, Space borne. Orbits: Geo Stationary satellite, Polar Orbiting satellite. Types & characteristics of sensors, Sensor resolution, Concept of Swath and Nadir, Image referencing system, Remote sensing data products: IRS, LANDSAT, SPOT, IKONOS, Quick Bird

Self - study component: Students shall collect the information on space research organizational structure ,Types of Indian satellites, and data products

MODULE-2	10 Hrs..

Thermal Remote Sensing; Thermal properties of materials:

Emissivity of materials; thermal inertia of Earth surface features; Thermal data sets: LANDSAT and ASTER; Concept and Principles of microwave remote sensing; Microwave data sets SLAR. LIDAR and SAR;

Application of Thermal and Microwave data; Digital Image processing: Introduction to Image, Digital image Types of Data Products, Types of image interpretation, Basic elements of image interpretation, Visual interpretation keys, Digital Image Processing, Preprocessing, image

enhancement techniques, multispectral image classification, Supervised and unsupervised.

Self-study component: Students shall collect the information on commercial and open-source Remote Sensing data for use in GIS. Download free DEM and LULC data.

MODULE-3	**10 Hrs..**

Introduction to GIS: Fundamentals of Geographic Information System: Basic Concepts: definition of GIS, Components of GIS, Variables - points, lines, polygon, Functionality of GIS, Recent trends and applications of GIS; GIS Softwares, Open-source GIS;

GIS Database: Geographic data: Spatial and non-spatial; Data models: Raster and vector; Database Management System (DBMS): Geo-database. Data Structures: Relational, hierarchical and network; Digitization of maps and imageries, Attribute data generation; Data Editing: Coordinate systems, Coordinate transformation. Reprojection.

Self-study component: Students shall collect the information on different commercial and open-source GIS software.

MODULE-4	**10 Hrs.**

Integrated Applications of Remote sensing and GIS

Applications in land use land cover analysis , Change detection , Water resources , Urban planning, environmental planning, Natural resource management and Traffic Management , Location based services and its applications.

Introduction to Global Positioning System (GPS): GPS satellites constellations; GPS segments: Space, Control, User; GPS antennas, signals, and codes; GPS receivers; Modes of measurements and post processing of data; Accuracy of GPS measurements; Application of GPS.

Self-study component: Students shall collect the information on different GPS system in world and their working

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	Remote Sensing and Image Interpretation, 7th Edition , ISBN: 978-1-118-34328-9	Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman	7th Edition	Wiley	January 2015
2.	REMOTE SENSING AND GIS	Basudeb Bhatta	3rd Edition	OUP India	27 January 2021

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Remote sensing and Geographical information system	Anji Reddy M.	4TH EDITION	B. S. Publications 2	2012
2	Basics of remote sensing & GIS	S Kumar,	First Edition	Laxmi publications	2016
3	Remote sensing of the environment	John R. Jensen,	2nd Edition	Pearson Education	2013

EBooks and online course materials:

1. **https://science.iirs.gov.in/wp-content/uploads/2024/09/Overview_of_Remote_Sensing_and_GIS_Applications_E-Book.pdf**
2. **https://www.gisresources.com/wp-content/uploads/2013/09/anji-reddy_GIS.pdf**

Online Courses and Video Lectures:

1. **https://onlinecourses.nptel.ac.in/noc22_ce84/preview**
2. **https://archive.nptel.ac.in/courses/105/103/105103193/**
3. **https://www.iirs.gov.in/pgdiploma**

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted Details of activity : **Analysis of Remote Sensing Data Sets**: Students explore and write about various types of remote sensing data sets	20

	(e.g., optical, microwave, thermal) and their applications, discussing the advantages and limitations of each. Details of activity 2 : **GIS Theory and Case Study Presentation**: Students write a detailed case study on how GIS is used in real-world scenarios (e.g., environmental monitoring, urban planning) and present their findings.	
Total		**50**

Course Articulation Matrix

Course Outcomes	**Program Outcomes**												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**3**	**2**											
CO2	**3**	**2**											
CO3	**3**	**2**											
CO4									**3**	**2**			

Course Title	ENGINEERING HYDROLOGY		
Course Code	23OECV667	(L-T-P)C	(3-0-0)3
Exam	03 Hrs	Hours/Week	3
SEE	100 Marks	Total Hours	40

Course Objective: Develop understanding about different components of the hydrological cycle
Enable the students to estimate runoff, infiltration, evaporation, groundwater flow and peak floods.

Course Outcomes:

#	At the end of the course the student will be able to:	Mapping to POs
1	Understand the significance of the hydrological cycle and different sources of water and rainfall distribution.	PO1
2	Apply methods for the measurement and analysis of inflow and outflow	PO1
3	Apply stage-discharge relationships and unit hydrograph theory for flood prediction and water management.	PO1
4	Apply the knowledge of IMD, stream gauging, and groundwater monitoring stations to observe, collect data, and prepare reports to real-world hydrological systems	PO6, PO8, PO9

MODULE-1	10 Hrs.

Hydrological cycle-types of representation, Water budget equation. Climatic seasons in India. Precipitation: Definition, Types and Forms of precipitation, Rain gauges - Types, Rain gauge network, Optimum number of rain gauges. Consistency of rainfall data.

Self-study component: Students should prepare a report on following a) *visit a nearby Rain Gauge Station to observe the typical arrangements*

MODULE-2	10 Hrs..

Infiltration, Definition, processes, factors affecting infiltration. Measurement of infiltration (double ring infiltrometer), Horton's infiltration curve and infiltration indices.

Evaporation, Definition, process, factors affecting evaporation and measurement of evaporation by IS pan.

Evapo-transpiration. Definition, PET and AET, factors affecting Evapo-transpiration and estimation of Evapo-transpiration by Blaney–Criddle equation and Lysimeters.

Self-study component: Students should prepare a report: *Visit a nearby IMD station and collect layout details for rain gauge, evaporation pans, anemometer, and sunshine recorder.*

MODULE-3	10 Hrs..

Stream Gauging. Introduction Measurement of stage and velocity using current meters and float. Computation of discharge by Area-Velocity and Slope-Area methods. Simple stage–discharge curve. **HydrographTheory**:Definition, concept and types of hydrographs. Components of hydrograph, separation of base flow. Unit hydrograph theory, derivation and application of unit hydrograph. ***Self-study component:*** *Students should prepare a report on stream gauging station, stage discharge curve. Simple hydrograph on stream flow data of the nearby station.*
MODULE-4 **10 Hrs.**
Ground Water Hydrology and Well Hydraulics: Scope and importance of ground water and availability of groundwater. Aquifers, aquitard, aquifuge, aquiclude, perched aquifer, and Aquifer parameters, Darcy's law and its validity. Steady radial flow into a well in confined and unconfined aquifers. ***Self study component:*** *Students shall visit the District Geologist's office and learn about underground aquifers and rock formations, rainwater harvesting and recharging of underground water. Ground water level monitoring.*

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Engineering Hydrology.	Subramanya, K.		India: McGraw Hill Education (India) Private Limited.	(2013).
2	A Textbook of Hydrology.	Reddy, P. J. R.		India: University Science Press	(2011).

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	"Hydrology",	Ojha, C.S.P.,		Oxford University Press,	2008.
2	Hydrology and water resources engineering	Garg. S. K.		Khanna Publication,	2004.

EBooks and online course materials:

1. **https://books.google.co.in/books?id=Nh8Y3vIjXK8C&printsec=frontcover&redir_esc=y#v=onepage&q&f=false**

Online Courses and Video Lectures:

1. https://youtu.be/IphCId7mkhk

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	Three CIEs conducted for 20 marks each and reduced to 10 marks	30

Activity Details	Details of activities to be conducted 1. Apply the knowledge of IMD, stream gauging, and groundwater monitoring stations to observe, collect data, and prepare reports to real-world hydrological systems	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**2**												
CO2	**3**												
CO3	**3**												
CO4						**2**		**2**	**2**				

Course Title	SOFTWARE APPLICATION LABORATORY		
Course Code	23CVL606	**(L-T-P)C**	(0-0-2) 1
Exam	3 Hrs.	**Hours/Week**	02 Hrs.
SEE	100 Marks	**Total Hours**	28

Course Objective: To equip with all necessary software skills to apply, analyze and develop engineering design in the advanced technological areas**.**

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Write programs to solve Problems in Civil Engineering using C/C++ programming / Matlab	PO1,PO2,PO5	PSO2
2	Use commercially available software packages for analysis and design of structures	PO1,PO2,PO3, PO5	PSO2
3	Use Excel programming for typical problems in Civil Engineering	PO1,PO2,PO3, PO5	

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1.	CAD Laboratory (Civil Engg)	Dr. G. S. Suresh and Dr. M.N. Sheshaprakash	1st	Laxmi Publications	2016
2.	CAD Laboratory	Dr. M. A. Jayaram and Dr. D. S Rajendraprasad		Sapna Publications	2003

EBooks and online course materials:

1. https://www.youtube.com/watch?v=G1GZsui9xbw
2. https://www.youtube.com/watch?v=B_fDh_xMfuo

Online Courses and Video Lectures:

1. https://onlinecourses.nptel.ac.in/noc20_ge05/preview
2. https://www.youtube.com/watch?v=G1GZsui9xbw
3. https://www.youtube.com/watch?v=B_fDh_xMfuo

Proposed Assessment Plan (for 50 marks of CIE):

Tool	Remarks	Marks
CIE	One CIEs conducted for 20 marks	20

Activity Details	Details of activities to be conducted Lab Record	30
Total		**50**

Laboratory Plan:

Lab Program	Program Details
1	Writing the programs to find SF and BM and to draw BMD and SFD for the following cases due to combination of point load and UDL for Cantilever beams – Simply supported beams – Propped cantilever beams – Fixed beams.
2	Writing the programs for Design of Rectangular Singly and Doubly Reinforced RC beams by limit state method.
3	Use of commercial software packages for analysis of beams and frames.
4	Use of Spreadsheet for - Design of horizontal and vertical alignment of curves - Design of super-elevation - Computation of earthwork - Balancing of closed traverse using transit rule. Water hammer analysis- Head over Ogee weir -Verification of stability of dams - most economical section of canal, derivation of unit hydrograph and hydrograph of different base periods.
5	Using MATLAB / R-Programming / product of matrices, for matrix operations like addition, subtraction, and inverse of matrices.

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1	**3**	**2**			**3**								**2**
CO2	**3**	**2**	**2**		**3**								**2**
CO3	**3**	**2**	**2**		**3**								

Course Title	ADVANCED SURVEY TRAINING		
Course Code	23CV607	**(L-T-P)C**	(0-0-2) 1
Exam	3 Hrs.	**Hours/Week**	02
SEE	100 Marks	**Total Hours**	80 + 26 (Site + Lab)

Course Objective: To understand the basics elements of highway, existing old tank during preliminary survey and to extract the field data using total station for the necessary calculation works.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1	Apply Surveying knowledge and advanced tools effectively to conduct reconnaissance survey for selection of site for conceptualization of projects	PO4, PO5, PO9, PO11	PSO2
2	Design various components in Old tank, Water supply, Highway, Layout projects to prepare drawings with detailed report using total station instruments.	PO4, PO5, PO9, PO11	PSO2

MODULE-1	**26 Hrs.**

Preliminary Training: During the Preliminary Training, the students will learn the following survey exercises using total station: Measurement of the distance, vertical and horizontal angles, bearings, heights, reduced Levels (RL), Transfer of data from total station to computer and vice- versa, Preparation of drawings after processing of the data.

Highway Project: Preliminary and detailed investigations to align a new road between two arbitrary points. The investigations shall consist of topographic surveying of strip of land for considering alternative routes and for deciding final alignment. Preparation of report to justify the selected alignment with details of all geometric design details. Preparation of Drawings including key plan initial alignment, final alignment, longitudinal section along with final alignment and typical cross sections of road.

MODULE-2	**26 Hrs..**

Layout planning of a housing colony: Works involved - Preparation of site map, Planning and marking of sites, roads, cross drainage works and amenities like: water supply, electricity, sanitation, location of GLSR, overhead tank and UGD system with STP.

MODULE-3	**26 Hrs..**

Survey of an existing Old Tank: Works involved -Survey of existing bund, longitudinal and cross sections showing the details of Sluice, Waste-weir and other facilities. Plotting of capacity contours. Measurement of gradient of existing channel. Preparation of drawings, indicating cross sections and locations of waste weir and sluice

MODULE-4	**26 Hrs.**

Marking of proposed building center line: Works involved - Selection of location for setting of the instrument. Working out the coordinates of points on centerline with reference to the instrument location. Transferring of the coordinates on to the ground.

Prescribed Text Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Surveying	Basak. N. N		Tata McGraw Hill Publishing Co., ltd	2004
2	Irrigation and Water Power Engineering	Punmia, B. C		Laxmi Publications	1992

Reference Books:

Sl.No	Book Title	Authors	Edition	Publisher	Year
1	Highway Engineering	Khanna, S. K. & Justo CES,		Nemchand Brothers,	2003
2	Water Supply Engineering	Garg, S. K.,		Khanna Publishers,	2007

EBooks and online course materials:

https://onlinecourses.nptel.ac.in/noc22_ce05/preview

Proposed Assessment Plan (for 50marks of CIE):

Tool	Remarks	Marks
CIE	One CIE will be conducted for 30 marks covering all the aspects of the advanced survey training camp report.	30
Activity Details	Details of activities to be conducted Submission of report containing theory part, calculations & drawings.	20
Total		**50**

Course Articulation Matrix

Course Outcomes	Program Outcomes												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PSO1**	**PSO2**
CO1				2	3				2		1		
CO2				2	3				2		1		