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

(2022-23 Admitted Batch)

Academic Year: 2024-25

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)

Engineering Graduates will be able to:

1. **Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem Analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct Investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and
environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering
practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in
multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Objectives (PSOs)

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	Weightage in Marks
CIE-1	Syllabus to be decided by the Course Coordinators such that all the 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.

FIFTH SEMESTER						
Sl. No.	**Course Category and Course Code**		**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
1.	PCC	22CV501	Advanced Structural Analysis	2-2-0	3	4
2.	PCC	22CV502	Construction Planning and Management	3-0-0	3	3
3.	IPCC	22CV503	Geotechnical Engineering	3-0-2	4	3
4.	IPCC	22CV504	Transportation Engineering	3-0-2	4	3
5.	PCCL	22CV505	Environmental Engineering Laboratory	0-0-2	1	3
6.	PEC	22CV55X	Professional Elective Course	3-0-0	3	3
7.	AEC	22RIP	Research Methodology and IPR	3-0-0	3	2
8.	HSMC	22EVS	Environmental Studies	0-0-2	1	2
				Total	**22**	**23**
	PCC: Professional Core Course; IPCC: Professional Core Course Theory Integrated with Practical of the same course PCCL: Professional Core Course Laboratory AEC: Ability Enhancement Course; UHV: Universal Human Value Courses					

FIFTH SEMESTER: PROFESSIONAL ELECTIVES						
Sl. No.	**Course Category and Course Code**		**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
1.	PEC	22CV551	Occupational Safety and Health assessment	3-0-0	3	3
2.	PEC	22CV552	Remote Sensing and GIS	3-0-0	3	3
3.	PEC	22CV553	Waste Water Engineering	3-0-0	3	3
4.	PEC	22CV554	Energy and Environment	3-0-0	3	3
5.	PEC	22CV555	Satellite Imagery in GIS	3-0-0	3	3
6.	PEC	22CV556	Groundwater Development and Management	3-0-0	3	3
7.	PEC	22CV557	Repair and Rehabilitation of Structures	3-0-0	3	3
8.	PEC	22CV558	Stability Analysis of Slopes	3-0-0	3	3
9.	PEC	22CV559	Advanced Construction Materials and Green Buildings	3-0-0	3	3
	PCC: Professional Core Course; IPCC: Professional Core Course Theory Integrated with Practical of the same course PCCL: Professional Core Course Laboratory AEC: Ability Enhancement Course; UHV: Universal Human Value Courses					

SIXTH SEMESTER						
Sl. No.	**Course Category and Course Code**		**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
1.	IPCC	22CV601	Design and Detailing of RC Structures	3-0-2	4	3
2.	PCC	22CV602	Irrigation Engineering and Hydraulic Structures	3-0-0	3	3
3.	PCC	22CV603	Applied Geotechnical Engineering	3-0-0	3	3
4.	PIC	22PROJ1	Main Project work Phase-1	0-0-4	2	3
5	PEC	22CV65X	Professional Elective Course	3-0-0	3	3
6.	OEC	22OECV66X	Open Elective Course-1	3-0-0	3	3
7.	PCCL	22CVL606	Software Application Lab	0-0-2	1	3
8.	PCC	22CV607	Advanced Survey Training	0-0-2	2	3
9.	OEC	22SWY	*Swayam (NPTEL only)	AUDIT		
10.	AEC/SDC	22ASK	Analytical ability & soft skills	0-0-2	1	1
				Total	**22**	**25**
	PCC: Professional Core Course; IPCC: Professional Core Course Theory Integrated with Practical of the same course PCCL: Professional Core Course Laboratory AEC: Ability Enhancement Course; UHV: Universal Human Value Courses					

Note: Analytical ability & soft skills (AEC/SDC) course will be conducted by Training and Placement office

SIXTH SEMESTER: PROFESSIONAL ELECTIVES						
Sl. No.	**Course Category and Course Code**		**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
1.	PEC	22CV651	Matrix Methods of Structural Analysis	3-0-0	3	3
2.	PEC	22CV652	Structural dynamics	3-0-0	3	3
3.	PEC	22CV653	Soft Computing and Automation in Civil Engineering	3-0-0	3	3
4.	PEC	22CV654	Industrial Waste Water Treatment	3-0-0	3	3
5	PEC	22CV655	Ground Improvement Techniques	3-0-0	3	3
6.	PEC	22CV656	Traffic Engineering	3-0-0	3	3
7.	PEC	22CV657	Rural Water Supply & Sanitation	3-0-0	3	3
8.	PEC	22CV658	Environmental Impact Assessment	3-0-0	3	3
9.	PEC	22CV659	Theory of Elasticity	3-0-0	3	3
10.	PEC	22CV660	Urban Transportation Planning	3-0-0	3	3
11.	PEC	22CV661	Groundwater Hydraulics	3-0-0	3	3

12.	PEC	22CV662	Modern Construction Methods and Mechanization	3-0-0	3	3
	PCC: Professional Core Course; IPCC: Professional Core Course Theory Integrated with Practical of the same course PCCL: Professional Core Course Laboratory AEC: Ability Enhancement Course; UHV: Universal Human Value Courses					

SIXTH SEMESTER: OPEN ELECTIVES						
Sl. No.	**Course Category and Course Code**		**Course Title**	**L-T-P**	**Credits**	**Contact Hours**
1.	OEC	22OECV661	Engineering Seismology	3-0-0	3	3
2.	OEC	22OECV662	Water Supply and Sanitation	3-0-0	3	3
3.	OEC	22OECV663	Composite and Smart Materials	3-0-0	3	3
4.	OEC	22OECV664	Urban Design and Regeneration	3-0-0	3	3
5.	OEC	22OECV665	Hazardous Waste Management	3-0-0	3	3
6.	OEC	22OECV666	Sustainable Development Goals	3-0-0	3	3
7.	OEC	22OECV667	Railway Engineering	3-0-0	3	3
8.	OEC	22OECV668	Remote Sensing and GIS	3-0-0	3	3
9.	OEC	22OECV669	Advanced Construction Materials and Green Buildings	3-0-0	3	3
	PCC: Professional Core Course; IPCC: Professional Core Course Theory Integrated with Practical of the same course PCCL: Professional Core Course Laboratory AEC: Ability Enhancement Course; UHV: Universal Human Value Courses					

Course Title	ADVANCED STRUCTURAL ANALYSIS		
Course Code	22CV501	(L-T-P) C	(2-2-0)3
Exam	3 Hrs.	Hours/Week	4
CIE+SEE	50+50 Marks	Total Hours	50

Course Objective:

To impart knowledge about various methods involved in the analysis of determinate and indeterminate structures.

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

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Comprehend the knowledge of structures and analysis of trusses and arches	PO1, PO2, PO3	
CO2	Comprehend the knowledge of structures and analysis of cables and continuous beams.	PO1, PO2, PO3	
CO3	Carryout analysis of indeterminate structures by slope deflection method	PO1, PO2, PO3	
CO4	Carryout analysis of indeterminate structures by moment distribution method	PO1, PO2, PO3	

MODULE – 1	13 Hrs.

Plane Trusses: Behavior of trusses, assumptions, analysis of statically determinate plane trusses by method of joints & method of sections.

Arches: Three hinged circular & parabolic arches with supports at same & different levels, determination of horizontal thrust, normal thrust, radial shear & bending moment.

Self-Study Component: The students shall visit different structural arrangements pertaining to trusses and arches.

MODULE – 2	12Hrs.

Cables: Analysis of cables under point loads & UDL, length of cables - Supports at same & at different levels.

Displacements of structures: slopes and deflection of cantilever, bent ups & simply supported beams by unit load method.

Self-Study Component: The students shall visit different structural arrangements pertaining to cables and learn to identify their structural action.

MODULE -3	13 Hrs.

Slope Deflection Method: Development of Slope- Deflection equations - Analysis of Continuous Beams and orthogonal rigid jointed Plane frames with kinematic indeterminacy not more than three. (both sway & non-sway type).

Self-Study Component: The students shall visit different construction sites and learn to identify &understand the behaviour of determinate and indeterminate structures.

MODULE -4	12 Hrs.

Moment Distribution Method: Carry over factor, Distribution factor, Analysis of orthogonal rigid jointed Plane sway frames with kinematic indeterminacy not more than three.

Consistent deformation method Analysis of propped cantilever and fixed beams.

Self-Study Component: The students shall visit different construction sites and learn to identify & understand the behaviour of determinate and indeterminate structures.

Text Books:

1) Vazirani V. N. & Ratwani M. N. – "Analysis of Structures" – Vol. II, 15th Ed., Khanna publications, New Delhi, 2002
2) Reddy C. S., "Basic Structural Analysis" second Ed., Tata Mc Graw Hill Publishing Co.ltd, 2006

Reference Books:

1) Ramamrutham. S, "Theory of Structures" Dhanpath Rai Publications, New Delhi –2008
2) Wang C.K., "Statically indeterminate structures" Tata McGraw Hill Publishing Co. Ltd, Tokyo, 1952.
3) STAAD.Pro -Manual

MOOC Course:

1) https://www.classcentral.com/course/swayam-structural-analysis-i-14313

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	3	1											
CO2	2	3	1											
CO3	2	3	1											
CO4	2	3	1											

Course Title	CONSTRUCTION PLANNING AND MANAGEMENT		
Course Code	22CV502	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective: Analyze methods, materials, and equipment used to construct projects Apply construction management skills as a member of a multi- disciplinary team

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

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Illustrate the basic concepts of engineering economic analysis for deciding project feasibility by comparison of alternative project proposals	PO2, PO6, PO11	
CO2	Apply linear programming as a tool for optimization by graphical and simplex method	PO1, PO6, PO11	
CO3	Distinguish the concept of construction management and employ construction planning methods to achieve optimum cost by CPM and PERT	PO1, PO6, PO11	
CO4	Describe the sequential process of construction, project management and transportation problems for optimum results.	PO2, PO6, PO11	

MODULE – 1	10Hrs.

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	11 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	09 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.

Text Books:

1) Subramaniam.K"ConstructionManagement",AnuradhaPublishers,Madras,1989(Ch.1–5)
2) Peurifoy, R L "Construction Planning equipments and methods" McGraw Hill Publications 3rdedition,1985

Reference Books:

1) Mahesh Varma "Construction Planning and Management" Metropolitan Book Co.Delhi1982
2) Sharma.S.D. "Operation Research" Khanna Publishers, NewDelhi.

MOOC/NPTEL Course:

1.NPTEL :: Civil Engineering - Construction Planning and Management

2.NPTEL : NOC:Scheduling Techniques in Projects (Civil Engineering) (digimat.in)

3.Construction Management NPTEL - YouTube

Course Articulation Matrix

	Program Outcomes [POs]												
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		3				1	1				3			
CO2	2					1	1				3			
CO3	2					1	1				3			
CO4		3				1	1				3			

Course Title	GEOTECHNICAL ENGINEERING		
Course Code	22CV503	(L-T-P) C	(3-0-2) 4
Exam	3 Hrs.	Hours/Week	5
CIE+SEE	50+50 Marks	Total Hours	50 (40L +10P)

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 course, student will be able to:

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	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	
CO2	Apply the mechanism of flow of water through soil in the context of design and construction of embankments, canals etc.	PO1, PO2, PO3, PO4	
CO3	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	
CO4	Investigate and report on shear strength parameters of soil involving geo-physical exploration methods of subsurface investigation.	PO1, PO2, PO3, PO4	

MODULE – 1 — 13 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

test.

Laboratory component:

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.

MODULE – 2	**12 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 location within the campus.

Laboratory component:

1. Determination of coefficient of permeability of soil sample by constant & variable head method.

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.

Laboratory component:

1) Determination of compaction characteristics of soil by standard & modified Proctor test.

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.

Laboratory component:

1) Determination of Shear strength parameters of soil by Direct shear Test.
2) Determination of shear strength parameters of soil sample by Tri axial shear test and unconfined compression test.

Text Books:

1) Murthy, V.N.S., " Principles of Soil Mechanics and Foundation Engineering", 5th Revised Ed., UBS Publishers and Distributors ltd, NewDelhi, 2001.
2) Punmia, B.C. Ashok Kumar Jain & Arun Kumar Jain, "Soil Mechanics and Foundations", Laxmi Publishing Co., New Delhi. 2003.

Reference Books:

1) Bowles, J.E, "Foundation Analysis and Designs" 5th Ed. Mc Graw Hill Publishing, New York – 2008.
2) Venkataramaiah,C., "Geotechnical Engineering", Revised third Ed., New Age International publishers, 2006

MOOC Course:

1) NPTEL:: Civil Engineering - NOC:Geotechnical Engineering - 1

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	2		2										
CO2	3	2	2	1										
CO3	3	2	2	2										
CO4	3	2	2	1										

Laboratory Rubrics

	Excellent	Very Good	Good	Average
Records. /20	•Comprehensive and well-organized records • All entries are accurate, complete, and clearly documented •Detailed observations and results are presented systematically (10)	•Good organization and mostly accurate entries •Minor errors or omissions in the records •Observations and results are presented, but lack some detail(8)	•Basic organization with several inaccuracies •Significant errors or omissions in the records •Observations and results are incomplete or unclear(6)	•Poorly organized records with many inaccuracies •Major errors or omissions throughout • Observations and results are largely missing or very unclear (4)
Procedure /10	•Procedure followed precisely as outlined in the manual •Clear, logical, and methodical execution of each step •No deviations or mistakes during the process(3)	•Procedure followed correctly with minor deviations •Logical execution with some small errors •Minor steps missed or executed incorrectly (2) .	•Procedure partially followed with significant deviations •Execution lacks clarity and has noticeable errors •Several steps missed or executed incorrectly(1)	•Procedure not followed correctly •Execution is disorganized and unclear • Many steps missed or executed incorrectly(0)
Conductio n /10	•Excellent execution of the experiment •All apparatus used correctly and safely •Results obtained are highly accurate and reliable(5)	•Good execution with minor errors •Apparatus used mostly correctly with some small mistakes •Results obtained are fairly accurate and reliable (3)	•Basic execution with noticeable errors •Apparatus used with several mistakes •Results obtained are somewhat accurate but less reliable(1)	•Poor execution with many errors •Apparatus used incorrectly or unsafely •Results obtained are inaccurate and unreliable(0)
Viva Voce /10	•Excellent understanding of the experiment and underlying concepts •Answers to questions are clear, concise, and correct •Demonstrates a high level of confidence and competence(2)	•Good understanding with minor gaps in knowledge •Answers to questions are mostly correct with minor errors •Demonstrates reasonable confidence and competence(1)	•Basic understanding with several gaps in knowledge •Answers to questions are partially correct with noticeable errors •Demonstrates limited confidence and competence(0.5)	•Poor understanding with many gaps in knowledge •Answers to questions are mostly incorrect or unclear •Demonstrates low confidence and competence(0)

Course Title	TRANSPORTATION ENGINEERING		
Course Code	22CV504	(L-T-P) C	(3-0-2)4
Exam	3 Hrs.	Hours/Week	5
CIE+SEE	50+50 Marks	Total Hours	50(40 L + 10P)

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

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

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Conduct necessary field investigation for generation of required data for proposing new alignment or re-alignment of existing roads.	PO1, PO2, PO3	
CO2	Evaluate the engineering properties of the materials and suggest the suitability of the same for the pavement construction.	PO1, PO2, PO3	
CO3	Design the thickness of pavement (Flexible and Rigid) and various pavement evaluation methods.	PO1, PO2, PO3	
CO4	Evaluate the condition of highway drainage and associated problems and to evaluate the highway economics by various methods.	PO1, PO2, PO3	

MODULE – 1	12 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 condition.

MODULE – 2	14 Hrs.

Highway Geometric Design (No Derivation) – Importance – Controlling factors –Design speed- Surface 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	**14 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.

Practical Component:

Laboratory experiments:(Module – 02)

a) Testing of fine aggregate: Specific Gravity, sieve analysis and zoning, bulking of fine aggregate, bulk density, silt content.

b) Testing of coarse aggregate: Specific Gravity, sieve analysis, bulk density, flakiness index, elongation index, water absorption & moisture content, soundness of aggregate.

(Module – 03)

a) Concrete Mix design by IS code method as per 10262- 2019 & 456-2000

b) Demonstration of testing of concrete cube of specified strength

c) Marshall stability method.

Text Books:

1) Khanna and Justo – "Highway Engineering" Revised 10th edition, Khanna publications New Delhi (2017), ISBN: 8185240930.
2) Kadiyali, L.R., "Highway Engineering, Khanna Publishers", New Delhi (2023), ISBN: 9788193328439.

Reference Books:

1) Indian Roads Congress, Manual for Road Investment Decision Model, IRC Special Publication – 38, IRC, New Delhi, 1992.
2) IRC: 37-2012, Guidelines for the Design of Flexible Pavements, Indian Roads Congress, New Delhi.
3) IRC 58 - 2015, Guidelines for the Design of Rigid Pavements, Indian Roads Congress, New Delhi.

MOOC Course:

1) Geometric Design of Highways, IIT Roorkee, https://nptel.ac.in/courses/105107220

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	2	2											
CO2	3	2	2											
CO3	3	2	3											
CO4	3	2	2											

Laboratory Rubrics

	Excellent	Very Good	Good	Average
Records. /20	•Comprehensive and well-organized records • All entries are accurate, complete, and clearly documented •Detailed observations and results are presented systematically (10)	•Good organization and mostly accurate entries •Minor errors or omissions in the records •Observations and results are presented, but lack some detail(8)	•Basic organization with several inaccuracies •Significant errors or omissions in the records •Observations and results are incomplete or unclear(6)	•Poorly organized records with many inaccuracies •Major errors or omissions throughout • Observations and results are largely missing or very unclear (4)
Procedure /10	•Procedure followed precisely as outlined in the manual •Clear, logical, and methodical execution of each step •No deviations or mistakes during the process(3)	•Procedure followed correctly with minor deviations •Logical execution with some small errors •Minor steps missed or executed incorrectly (2) .	•Procedure partially followed with significant deviations •Execution lacks clarity and has noticeable errors •Several steps missed or executed incorrectly(1)	•Procedure not followed correctly •Execution is disorganized and unclear • Many steps missed or executed incorrectly(0)
Conductio n /10	•Excellent execution of the experiment •All apparatus used correctly and safely •Results obtained are highly accurate and reliable(5)	•Good execution with minor errors •Apparatus used mostly correctly with some small mistakes •Results obtained are fairly accurate and reliable (3)	•Basic execution with noticeable errors •Apparatus used with several mistakes •Results obtained are somewhat accurate but less reliable(1)	•Poor execution with many errors •Apparatus used incorrectly or unsafely •Results obtained are inaccurate and unreliable(0)
Viva Voce /10	•Excellent understanding of the experiment and underlying concepts •Answers to questions are clear, concise, and correct •Demonstrates a high level of confidence and competence(2)	•Good understanding with minor gaps in knowledge •Answers to questions are mostly correct with minor errors •Demonstrates reasonable confidence and competence(1)	•Basic understanding with several gaps in knowledge •Answers to questions are partially correct with noticeable errors •Demonstrates limited confidence and competence(0.5)	•Poor understanding with many gaps in knowledge •Answers to questions are mostly incorrect or unclear •Demonstrates low confidence and competence(0)

Course Title	ENVIRONMENTAL ENGINEERING LABORATORY		
Course Code	22CV505	(L-T-P) C	(0-0-2)1
Exam	3 Hrs	Hours/Week	2
CIE+SEE	50+50 Marks	Total Hours	28

Course Objective:

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: Upon completion of the course, students shall be able to

COs	Course Outcomes	Mapping to POs	Mapping to PSOs
CO1	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, PO7, PO9	-
CO2	Estimate the parameters of wastewaters for its suitability to discharge the environmental pollutants as per specifications	PO1, PO4, PO7, PO9	-

List of experiments

1) Determination of Solids in Sewage: Total Solids - Suspended Solids - Dissolved Solids - Volatile Solids - Fixed Solids – Settleable Solids.
2) Determination of Chlorides
3) Determination of Alkalinity, Acidity and pH
4) Determination of Calcium, Magnesium and Total Hardness
5) Determination of Dissolved Oxygen, BOD and COD
6) Determination of percentage of available chlorine in bleaching powder, residual Chlorine and Chlorine Demand
7) Jar Test for Optimum Dosage of Alum – Turbidity determination by Nephelometer
8) Determination of Nitrates, Sulphates, iron and fluoride using Spectrophotometer
9) Determination of Iron by Phenanthroline method and Fluorides by SPADNS Method
10) Determination of MPN

Reference Books:

1) Manual of Water and Wastewater Analysis – NEERI Publication
2) American Public Health Association (2012). "Standard methods for the examination of water and wastewater". 22nd Edition edited by Rice, E.W., Baird, R.B., Eaton, A.D., and Clesceri,

L.S.

3) American Public Health Association (APHA), American Water Works Association (AWWA) and Water Environment Federation (WEF), Washington, D.C., USA.
4) IS Standards – 2490-1974, 3360-1974, 3307-1974, 10500:2012
5) Sawyer, C. N., McCarty P. L., and Parkin, G. F. (2009). "Chemistry for Environmental Engineering & Science", Tata McGraw Hill
6) Schedule VI, The Environmental (Protection) Act1986.

Course Articulation Matrix

Course Outcomes	**Program Outcomes [POs]**													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	1			3			2							
CO2	1			3			2							

Laboratory Rubrics

	Excellent	Very Good	Good	Average
Records. /20	•Comprehensive and well-organized records • All entries are accurate, complete, and clearly documented •Detailed observations and results are presented systematically (10)	•Good organization and mostly accurate entries •Minor errors or omissions in the records •Observations and results are presented, but lack some detail(8)	•Basic organization with several inaccuracies •Significant errors or omissions in the records •Observations and results are incomplete or unclear(6)	•Poorly organized records with many inaccuracies •Major errors or omissions throughout • Observations and results are largely missing or very unclear (4)
Procedure /10	•Procedure followed precisely as outlined in the manual •Clear, logical, and methodical execution of each step •No deviations or mistakes during the process(3)	•Procedure followed correctly with minor deviations •Logical execution with some small errors •Minor steps missed or executed incorrectly (2) .	•Procedure partially followed with significant deviations •Execution lacks clarity and has noticeable errors •Several steps missed or executed incorrectly(1)	•Procedure not followed correctly •Execution is disorganized and unclear • Many steps missed or executed incorrectly(0)
Conductio n /10	•Excellent execution of the experiment •All apparatus used correctly and safely •Results obtained are highly accurate and reliable(5)	•Good execution with minor errors •Apparatus used mostly correctly with some small mistakes •Results obtained are fairly accurate and reliable (3)	•Basic execution with noticeable errors •Apparatus used with several mistakes •Results obtained are somewhat accurate but less reliable(1)	•Poor execution with many errors •Apparatus used incorrectly or unsafely •Results obtained are inaccurate and unreliable(0)
Viva Voce /10	•Excellent understanding of the experiment and underlying concepts •Answers to questions are clear, concise, and correct •Demonstrates a high level of confidence and competence(2)	•Good understanding with minor gaps in knowledge •Answers to questions are mostly correct with minor errors •Demonstrates reasonable confidence and competence(1)	•Basic understanding with several gaps in knowledge •Answers to questions are partially correct with noticeable errors •Demonstrates limited confidence and competence(0.5)	•Poor understanding with many gaps in knowledge •Answers to questions are mostly incorrect or unclear •Demonstrates low confidence and competence(0)

Course Title	OCCUPATIONAL SAFETY AND HEALTH ASSESSMENT		
Course Code	22CV551	(L-T-P) C	(3-0-0)3
Exam	3 Hrs	Hours / Week	3
CIE+SEE	50+50 Marks	Total hours	40

Course Objective:

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 : Upon completion of the course, students shall be able to

COs	Course Outcomes	Mapping toPOs	Mapping to PSOs
CO1	Identify hazards in the workplace that pose a danger or threat to their safety or health and understand the laws governing OSHA	PO1, PO6, PO7	
CO2	Analyze the standards and programs of ergonomics at workplace	PO1, PO6, PO7	
CO3	Analyze the concept of fire accidents and its early detection and methods of extinguishing fire	PO1, PO6, PO7	
CO4	Describe the role of health and safety in the workplace pertaining to the responsibilities of workers, managers and supervisors	PO1, PO6, PO7	

Course Contents:

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.

MODULE –2	10 Hrs.

Ergonomics at Work Place: Ergonomics Task analysis, Preventing Ergonomic Hazards, Work space 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.

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.	
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	

Text Books:

1. Goetsch D.L., (1999), "Occupational Safety and Health for Technologists, Engineers and Managers", Prentice Hall.
2. Heinrich H.W., (2007), "Industrial Accident Prevention - A Scientific Approach", McGraw-Hill Book Company
3. National Safety Council and Associate (Data) Publishers Pvt. Ltd., (1991), "Industrial Safety and Pollution Control Handbook"

Reference Books:

1. Colling D.A., (1990), "Industrial Safety Management and Technology", Prentice Hall, New Delhi.
2. Della D.E., and Giustina, (1996), "Safety and Environmental Management", Van Nostrand Reinhold International Thomson Publishing Inc.

MOOC/NPTEL Courses:

1) Industrial Safety and Fire Safety Management. Dr. P.K.Ghosh&Mrs.Annapurna Adiley , Chhattisgarh Swami Vivekanand Technical University (CSVTU), Bhilai
2) https://onlinecourses.swayam2.ac.in/nou24_ge81/preview
3) Industrial Safety Engineering By Prof. Jhareswar Maiti | IIT Kharagpur
4) https://onlinecourses.nptel.ac.in/noc24_mg110/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	2					3								
CO2	3						2							
CO3	2						3							
CO4	3						2							

Course Title	REMOTE SENSING AND GIS		
Course Code	22CV552	(L-T-P) C	(3-0-0) 3
Exam	3 Hrs.	Hours / Week	3
CIE+SEE	50+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:

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Comprehending remote sensing entails understanding of Energy interactions.	PO1, PO2	
CO2	Applying remote sensing in data collection and analysis through different types of sensors & platforms	PO1, PO2	
CO3	Comprehend GIS : Managing , Analyzing ,Visualizing spatial data solutions.	PO1, PO2	
CO4	Develop a comprehensive report on different types of currently working satellites and their uses.	PO1, 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	10Hrs.

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 Data base: Geographic data: Spatial and non-spatial; Data models: Raster and vector; Database Management System (DBMS): Geo-database. Data Structures: Relational, hierarchical and network; Data input and scale: Nature and Source of data, 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.

Spatial analysis: Spatial overlay operations, network analysis and proximity analysis; 3D models; TIN, Types of DEM. Application of DEM, Raster to Vector vice versa conversion. Water shed delineation using topographic sheets. Estimation of reservoir capacity;

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.

Text Books:

1. Lillesand, Kiefer, Chipman, “Remote Sensing and Image Interpretation”, Wiley2011.
2. Basudeb Bhatta “Remote sensing and GIS” Oxford university Press, New Delhi, India,2021
3. Narayan Panigrahi, “Geographical Information Science”, and ISBN 10: 8173716285 / ISBN

13: 9788173716287, University Press2008.

4. Kang – T surg Chang, “Introduction to Geographic Information System”. Tata McGraw Hill Education Private Limited2015.

Reference Books:

1.Anji Reddy M., “Remote sensing and Geographical information system”, B. S. Publications2008.

2.S Kumar,“Basics of remote sensing & GIS”, Laxmi publications 2005

3. John R. Jensen, “Remote sensing of the environment”, an earth resources perspective–2nd edition– by Pearson Education2007

4. Chor Pang Lo and Albert K.W Yeung, “Concepts &Techniques of GIS”, PHI,2006

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	2												
CO2	3	2												
CO3	3	2												
CO4	3													

Course Title	WASTE WATER ENGINEERING		
Course Code	22CV553	(L-T-P) C	(3-0-0) 3
Exam	3 Hrs	Hours / Week	3
CIE+SEE	50+50 Marks	Total hours	40

Course Objective: To inculcate the basics concepts of wastewater treatment, its design and management

Course Outcomes : Upon completion of the course, students shall be able to

COs	Course outcomes	Mappingto POs	Mapping to PSOs
CO1	Estimate average and peak wastewater from a community and design suitable conveyance systems for sewage and storm water.	PO1, PO2, PO6, PO7	-
CO2	Evaluate wastewater quality to suggest suitable small scale treatment option	PO1, PO2, PO6, PO7	-
CO3	Design a comprehensive wastewater treatment system to achieve required quality standards for safe disposal and reuse of wastewater	PO1, PO2, PO6, PO7	PSO1
CO4	Design an effective and efficient sludge and wastewater disposal system	PO1, PO6, PO7	PSO1

Course Contents:

MODULE –1	10 Hrs.

Introduction: Wastewater disposal - Necessity for sanitation, types of sewerage systems and their suitability. **Quantity of Sewage:** Dry weather flow, factors affecting dry weather flow, Estimation of storm flow, Rational method and Empirical formulae of design of storm water drain, Time of concentration. **Design of Sewers:** Hydraulic formulae for velocity, self-cleansing and non-scouring velocities, Design of hydraulic elements for circular sewers flowing full and for partially full, Sewer pipe material, Shapes of sewers, laying of sewers, jointing and testing of sewers, ventilation and cleaning of sewer.

MODULE –2	10 Hrs.

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, maintenance of house drainage. Sewage Pumps - Need, Types of pumps and pumping stations. **Analysis of Sewage:** Physical, chemical, and biological characteristics, concepts of Aerobic and Anaerobic activity, CNS cycles, more emphasis on BOD and COD –significance, Sampling and techniques.

MODULE –3	10 Hrs.
Disposal of Effluents: By dilution, self-purification phenomenon, oxygen sag curve, Zones of purification, Sewage farming, sewage sickness, Disposal standards on land and water, Chlorination of sewage. **Treatment of Sewage:** Flow diagram of municipal sewage treatment plant. **Primary treatment:** screening, grit chambers, skimming tanks and design of primary sedimentation tank**.**	
MODULE – 4	**10 hrs.**
Secondary treatment: Trickling filter (introduction only), Activated sludge process - Principle and flow diagram, methods of aeration, modifications, F/M ratio, Design of ASP. Methods of sludge disposal: Sludge digestion and Sludge drying beds. **Miscellaneous Treatment Methods:** Septic tanks and Oxidation Pond. Introduction to RBC, UASB, Anaerobic filters.	
Self-Study: Student 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.	

Text Books :

1) S. K. Garg ―Environmental Engineering: Sewage Disposal and Air Po llution Engineering (Volume - 2), 33 Edition, 2015, Khanna Publishers, ISBN: 9788174092304, 8174092307.
2) Punmia B. C. and Jain A., "Environmental Engineering-II, ArihantPublications, 1995 (Ch. 1 & 2)

Reference Books:

1) Waste Water Treatment, Disposal and Reuse -Metcalf and Eddy inc, Tata McGraw Hill
2) Publications (2008 Edition), ISBN-10: 0071008241, ISBN-13: 978-0071008242
3) Wastewater treatment Concepts and Design Approach by Karia G.L., C hritian R.A. Second Edition, 2013. Prentice Hall India Private limited, ISBN-10: 8120328604, ISBN-13: 978-8120328600.
4) Water and Waste water Engineering Vol-II -Fair, Gayer and Okun, Wil ley publishers, NewYork.2008, ISBN-10: 0470411929, ISBN-13: 978-0470411926
5) Howard S. Peavy, DonaldR. Rowe, "Environmental Engineering", George Tchnobanoglous, McGraw Hill International Ed., 1996.
6) CPHEEO Manual on ―Wastewater Collection, Treatment and Disposal‖, Ministry of Urban Development, Government of India, New Delhi.

MOOC/NPTEL Courses:

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

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3	2												
CO2	2						3							
CO3	3	2											3	
CO4	3						2						3	

Course Title	ENERGY AND ENVIRONMENT		
Course Code	22CV554	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours / Week	3
CIE+SEE	50+50 Marks	Total hours	40

Course Objective: To provide comprehensive understanding of the complex interplay between energy production, consumption, and its environmental implications.

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

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Acquire a comprehensive understanding of various energy systems	PO1, PO6, PO7	
CO2	Examine different Renewable Energy Technologies	PO1, PO6, PO7	
CO3	Analyze Energy Policy and Regulation	PO1, PO6, PO7	
CO4	Explore the relationship between energy production, consumption, and climate change	PO1, PO6, PO7	

MODULE – 1	10Hrs.

Introduction to Energy Sources: Global Energy, Environmental Resources, Energy necessity and energy crisis.

Indian Energy Scenario: Energy Consumption needs and crisis, energy sources and availability.

Biomass: Introduction, Energy plantation, Agricultural residue, Urban organic waste, Bio-mass conversion technologies (wet and dry process).

Self-study component: Download the document of a Case Studies and Real-World Applications, submit a report.

MODULE – 2	10Hrs.

Hydropower: Site selection for hydroelectric power plants, classification of hydroelectric power plants, submergence, ecological imbalance, advantages and disadvantages of hydroelectric power plants, catchment area assessment.

Tidal Energy: OTEC (Ocean Thermal Electric Conversion), methods of ocean thermal electric power generation, site selection. Energy from tides – basic principles of tidal power, components of tidal power plant.

Self-study component: Study the Environmental Considerations and Technological Innovations and Challenges, submit a report.

MODULE -3	10 Hrs.

Solar Energy: Solar constants, solar radiation at earth surface, physical principles of conversion of solar radiation into heat. Concentrating collectors (focusing and non- focusing),Associated Environmental Effects

Wind Energy: Introduction, basic principles of wind energy conversion. Site selection considerations. Basic components of wind energy conversion system. Wind energy collectors

Self-study component: Study the Policy and Regulatory Framework and Environmental and Social Impacts, submit a report.

MODULE -4	10 Hrs.

Nuclear Energy: Necessity, general components of nuclear reactors, different types of reactors, breeding reactors, location of nuclear power plants, disposal of nuclear wastes, Associated Environmental Effects.

Natural gas: Classification and comparison of different gas turbine power plants, Associated Environmental Effects.

Bio-Gas: Generation, factors affecting bio-digestion, advantages of anaerobic digestion, classification of bio-gas plants.

Self-study component: Learn about natural gas processing facilities and Nuclear Safety and Regulation, submit a report.

Text Books:

1) Metcalf &EddyInc, (2003), "Wastewater Engineering, Treatment and reuse"- 4th Edition, Tata McGraw Hill Publishers Co.Ltd, New Delhi

2) Training Manual on O&M for Municipal Staff", Asian Development Bank, Government of Karnataka

3) CPHEEO,(1999), "Manual on water supply and Treatment", Ministry of Urban Development, GoI, NewDelhi.

4) CPHEEO,(1999),"Manual on Sewerage and Sewage Treatment", Ministry of Urban Development, GoI, NewDelhi.

Reference Books:

1. Hammer,M.J.,(1986),"Water and Wastewater Technology– SIVersion"-2nd Edition, John Wiley and Sons.
2. William L'Neumann,(1997)"Industrial Air Pollution Control Systems" –Mc Graw - Hill Professional.
3. Walski,T.M.(1987),"Analysis of Water Distribution Systems" –CBS Publications, NewDelhi.
4. Raju, B.S.N.,(1991), "Water Supply and wastewater Engineering–Tata Mc Graw - HillPublishingCo.Ltd.,
5. Manual on Solid waste Management" – CPHEEO (Recent Edition)

MOOC Course:

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3					1	2							
CO2	2					1	3							
CO3	3					2	1							
CO4	1					2	3							

Course Title	SATELLITE IMAGERY IN GIS		
Course Code	22CV555	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours / Week	3
CIE+SEE	50+50 Marks	Total hours	40

Course Objective: This course deals with processing of images which are digital in nature. Study of the subject is motivated by three major applications and will introduce various image processing techniques, algorithms and their applications

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

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Comprehend the image acquisition, satellite data acquisition and image display system	PO1, PO6	
CO2	Comprehend the basic concepts of image distortion and rectification	PO1, PO7	
CO3	Investigate the concept of Image enhancement and spatial statistics	PO4	
CO4	Classify and analyse images using ANN and integration with GIS.	PO4	

MODULE – 1	10 Hrs.

Introduction:

Introduction to satellite imagery, types of satellites, types of satellite images, imagery resolutions, Satellite Imagery Sources, image interpretation, Elements of interpretation, Processing and Classification of Remotely Sensed Images.

Self-study component: student shall study IMAGE CLASSIFICATION TECHNIQUES

MODULE – 2	10 Hrs.

Image Acquisition and Format: Satellite data acquisition, DN characters-kernels- storage devices, CC, CDisk, Optical disk. Data retrieval. Export and import, Data formats, BSQ, BIL, BIP, Run length encoding, Image Compression Data products, hard copy, digital products, Image display system, requirement.

Self-study component: student shall survey the area of MCE and interpret in digital formats.

MODULE -3	10 Hrs.

Image Distortion, Rectification and Image Enhancement

Introduction-Sensor model, Preprocessing and Post processing Geometric distortion, sources and causes for distortion, rectification, GCP, Resampling, Image registration, transformation, radiometric distortion, sources and causes, Computation of radiance, Computation of reflectance, cosmetic operations, Noise removal, atmospheric correction Satellite image statistics, Univariate and multi-variate statistics. Basics of Histogram, noise models, image quality, contrast manipulation, grey level thresholding, level slicing. Contrast stretching- Spatial feature manipulations, spatial filtering, convolution Low pass, high pass, edge enhancement, edge detection, Fourier analysis

Self-study component: students shall use satellite image enhancement techniques of Hassan city, our college area, etc

MODULE -4	**10 Hrs.**

Image Classification and Analysis:

Introduction, Classification techniques, feature extraction, Supervised, training stage, classification stage, scatterogram, minimum distance to mean classifier, Parallelepiped classifier, Gaussian maximum Likelihood classifier, Digital Image interpretation ,Pattern recognition, shape analysis, Textural analysis, Artificial Neural Network; Integration with GIS

Self-study component: Students shall analyze Detection of Change in multi-temporal images

Textbooks:

1. Bolstad, Paul, “Fundamentals of GIS”, Atlas Books, 2nd Edition, 2005.
2) Lillesand, Thomas M., Ralph W. Kiefer and Jonathan W.Chipman, “Remote Sensing and Image Interpretation”, Wiley, New York, 5th Edition, 2004.

Reference Books:

1. LRA Narayana, “Remote Sensing and its applications”, University Press 1999.
2. S.Kumar, “Basics of Remote Sensing & GIS”, Laxmi Publications, 2004.
3. M.Anji Reddy, “Remote Sensing and GIS”, B.S. Publications, New Delhi, 2008
4. Tsung Chang, “GIS”, TMH Publications & Co, 2007.

MOOC Course:

1. https://nptel.ac.in/courses/105103193/
2. https://nptel.ac.in/courses/121107009/
3. https://nptel.ac.in/courses/105108077/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2					3								
CO2	2						3							
CO3				3										
CO4				3										

Course Title	GROUNDWATER DEVELOPMENT AND MANAGEMENT		
Course Code	22CV556	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective:

1. 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:

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Distinguish various aquifer properties to be used in the differential flow equations of the groundwater.	PO1	-
CO2	Apply the knowledge to estimate various surface and subsurface investigations to be used in the groundwater explorations	PO1	-
CO3	Analyze the various recharge methods and effective basin management	PO2	-
CO4	Examine the various components of groundwater recharge methods through field visit and communicate and report the need for and importance of them	PO6, PO7	-

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	**10Hrs.**

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.

Text Books:

1) David Keith Todd and Larry W. Mays, "Groundwater Hydrology" 3rd Edition, JOHN WIELY, 2004.
2) H. M. Raghunath, "Ground Water" 3rd Edition, New Age International Publications, 2007.

Reference Books:

1) B.R.Chahar, "Groundwater Hydrology", 8th Edition, McGraw Hill Education, 2015.
2) R.Willes&W.W.G.Yeh, "Groundwater System Planning &Management", Prentice Hall of India, 2001.

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2													
CO2	3													
CO3		3												
CO4						2	2							

Course Title	REPAIR AND REHABILITATION OF STRUCTURES		
Course Code	22CV557	(L-T-P)C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 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:

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Identify the causes for structural (Concrete) deterioration.	PO1	
CO2	Analyze the type and extent of damage and carry out damage assessment of structures through various types of tests.	PO2	
CO3	Analyze the maintenance requirements of the buildings and preventive measures against influencing factors.	PO2	
CO4	Prepare a comprehensive report on deterioration of structural elements of the building	PO9, PO10	

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	10Hrs.

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

Self-studycomponent: 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 Shot Crete Epoxy injection, Mortar repair for cracks, shoring and underpinning**.**

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

Text Books:

1. Sidney, M. Johnson, "Deterioration, Maintenance and Repair of Structures"

2. Denison Campbell, Allen & Harold Roper, "Concrete Structures - Materials, Maintenance and Repair"- Longman Scientific and Technical.

Reference Books:

1) **R.T.Allen and S.C.** Edwards**, "Repair** of **Concrete Structures"-Blakie and Sons**

2) **Raiker R.N., "Learning for failure** from **Deficiencies in Design,** Construction **and Service"- R&**D **Center (SDCPL)**.

3) **CPWD Manual**

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3													
CO2		2												
CO3		3												
CO4									3	2				

Course Title	STABILITY ANALYSIS OF SLOPES		
Course Code	22CV558	(L-T-P) C	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective: The course aims at providing future civil engineers with a comprehensive view on soil slope stability. It addresses landslide types and mass movement classification; slope failure mechanisms and methods for slope stability analysis are discussed; remedial measures and risk analysis are presented.

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

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Analyze mechanics of slope failure and different modes of slope failures	PO2	
CO2	Analyze the stability of infinite and finite slopes	PO2	
CO3	Applying computer knowledge in rock slope analysis	PO3	
CO4	comprehend the stabilization methods and its application	PO3, PO7	

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 and slope stability 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.

Self-study component: student shall develop a MATLAB program for wedge analysis

MODULE -4	**10 Hrs.**

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, use of geo textiles, soil nailing, rock bolting and rock anchoring, grouting and shotcreting.

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

Text Books:

1. Chowdhary Robin and Chowdhary Indrajit , "Geotechnical Slope Analysis", CRC Press.
2) Hoek, E. and Bray, J.W., "Rock Slope Engineering" Institution of Mining Engineering.

Reference Books:

1. Singh, B. and Goel, R.K.,"Software for Engineering Control of Landslides and Tunneling Hazards", A A Balkema.
2) Wyllie Duncan C and Christofer W Mah," Rock Slope Engineering" Spon Press, Taylor and Francis Group

MOOC Course:

1. https://nptel.ac.in/courses/105101001
2) http://www.digimat.in/nptel/courses/video/105105168/L58.html
3) https://www.youtube.com/watch?v=3XBkgRuoFiE

Course Articulation Matrix

Course Outcomes	**Program Outcomes [POs]**													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		3												
CO2		3												
CO3			3											
CO4			3				2							

Course Title	ADVANCED CONSTRUCTION MATERIALS AND GREEN BUILDINGS		
Course Code	22CV559	(L-T-P) C	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective:

1. Understand and Apply Green Building Principles.
2. Explore Alternative and Sustainable Building Materials.

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

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Describe the green building materials and advanced energy-efficient design techniques with their environmental impacts	PO1	
CO2	Investigate feasibility and benefits of industrial waste products and develop sustainable integration strategies.	PO7	
CO3	Apply advanced concrete technologies to optimize durability, sustainability, and efficiency in diverse construction applications.	PO1, PO7	
CO4	Develop practical knowledge and observation skills for rating of green building using IGBC and LEED.	PO8, PO9,PO12	

MODULE – 1	10 Hrs.

Introduction: Energy in building materials, Environmental issues concerned to building materials, Embodied energy and lifecycle energy, Global warming and construction industry, Green concepts in buildings, Green building ratings IGBC and LEED manuals–mandatory requirements, Rainwater harvesting & Solar Passive Architecture, Environmental friendly and cost effective building technologies, Requirements for buildings of different climatic regions.

Self-study component: Students will refer to the IGBC manuals and compare the aspects with the conventional buildings.

MODULE–2	10Hrs.

Alternative Building Materials: Lime, Pozzolana cements, Raw materials, Manufacturing process, Properties and uses. Fiber metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from agro and industrial wastes, Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes.

Self-study component:Students will visit the Industries and Agricultural land and list out the possible alternative materials that can be incorporated in construction as Alternative Building materials.

MODULE -3	**10 Hrs.**

Special Concretes: Definition & Introduction, General properties, Advantages, Disadvantages, Applications, High density concrete, Shrinkage compensating concrete, Mass concrete, Roller compacted concrete. Lightweight concrete, High strength concrete, Ultra-high strength concrete (reactive powder concrete), High workability concrete/Self compacting concrete, Fiber reinforced concrete, Polymer-concrete composites.

Self-study component:Students will list out the special concrete and prepare the Mix design for the selected concrete.

MODULE -4	**10 Hrs.**

I**ntroduction to Sustainability**: Carbon cycle and role of construction material such as concrete and steel, etc. CO2 contribution from cement and other construction materials. Control of energy use in building, ECBC code, codes in neighboring tropical countries, features of LEED and TERI Griharatings,Sustainable Architecture and Design, Performance ratings of green buildings. Global temperature, Greenhouse effects, global warming. Acid rain - Causes, effects and control methods. Regional impacts of temperature change

Self-study component:Students will compare features of LEED and TERI Griha ratings for sustainable architecture.Investigate global temperature trends, greenhouse effects and assess regional impacts of temperature change on ecosystems and human health.

Text Books:

1) Alternative Building Materials and Technologies ,K. S. Jagadish, B. V. Venkatarama Reddy and KS NanjundaRao,New Age International Publishers
2) Sustainable Construction: Green Building Design and delivery C. J. Kibert 3 rd Ed., John Wiley, Hoboken, New Jersey 2008

Reference Books:

1) Concrete Technology :Gambhir M. L. McGraw Hill Education 2006
2) Concrete Technology: Shetty M.S. S. Chand and Company Ltd. Delhi 2003
3) Building Materialsin: Developing Countries RJS Spence andDJ Cook Wiley pub.
4) IGBC manual-Indian Green building council (igbc.in)

MOOC Course:

1) https://onlinecourses.swayam2.ac.in/nou24_ge85/preview
2) https://onlinecourses.nptel.ac.in/noc24_ar20/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO 2**
CO1	3													
CO2							3							
CO3	3						2	3	3			3		
CO4	3						3	3	3			3		

Course Title	RESEARCH METHODOLOGY & INTELLECTUAL PROPERTY RIGHTS		
Course Code	22RIP	(L-T-P) C	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 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:

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Carry out Literature Review and write technical paper	PO2, PO3, PO4, PO8, PO12	
CO2	Describe the fundamentals of patent laws and the patent drafting procedure.	PO6, PO8, PO10, PO12	
CO3	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.

Text Books:

1. Dipankar Deb, Rajeeb Dey, Valentina E, Balas, "Engineering Research Methodology", Springer, 2019.
2. Prof. Rupinder Tewari, Ms. Mamta Bhardwa, "Intellectual Property" , Professor Gurpal Singh Sandhu Honorary Director, Publication Bureau, Panjab University, 2021.

Reference Books:

1. David V. Thiel, "Research Methods for Engineers", Cambridge University Press, 2014.
2. N.K.Acharya, "Intellectual Property Rights", Asia Law House, 8th Edition, 2021.

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		3	2	3				2				3		
CO2						3		2		3		3		
CO3						3		2		3		3		

Course Title	ENVIRONMENTAL STUDIES		
Course Code	22EVS	(L-T-P) C	(0-0-2) 1
Exam	3 Hrs.	Hours/Week	2
CIE+SEE	50+50 Marks	Total Hours	20

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:

COs	Course Outcomes	Mapping to PO's	Mapping to PSO's
CO1	Acquire an awareness of sensitivity to the total environment and its allied problems.	PO7, PO9s	
CO2	Develop strong feelings of concern, sense of ethical responsibility for the environment and the motivation to act in protecting and improving it.	PO6, PO8	
CO3	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	5 Hrs.

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

MODULE – 2	5 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	5 Hrs.

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

MODULE -4	5 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.

Text Books:

1. Environmental Studies - Dr. D.L Manjunath, Pearson Education -2006
2. Environmental Studies - Dr. S. M. Prakash - Elite Publishers - 2006

Reference Books:

1. Environmental Studies - Benny Joseph - Tata McGraw ill- 2005
2. Principles of Environmental Science and Engineering P. Venugopala Rao, Prentice Hall of India.
3. Environmental Science and Engineering - Meenakshi, Prentice Hall India.

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1							3		3					
CO2						3		3						
CO3						3	3	3	2					

Course Title	DESIGN & DETAILING OF RC STRUCTURES		
Course Code	**22CV601**	**L-T-P**	**(3-0-2)4**
Exam	**3 Hrs.**	**Hours/Week**	**5**
CIE+SEE	**50+50 Marks**	**Total Hours**	**50 (40L +10P)**

Course Objective:

To understand and gain knowledge to build a structure that can effectively withstand the intended loads and meet the performance 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. Analysis of singly reinforced & doubly reinforced rectangular sections, as per the provisions of IS 456- 2000 in limit state of flexure.	PO1, PO2, PO3	-
2.	Examine the mechanism of RC sections in the limit state of serviceability in deflection and cracking. Design of beams as per IS:456-2000.	PO2, PO3, PO6	-
3.	Design the limit state of compression members – short columns and also design of slabs as per IS:456-2000.	PO1, PO2,PO3, PO6	-
4.	Design various types of footings and staircase as per IS: 456-2000.	PO1, PO2,PO3, PO6	-

MODULE – 1	**15Hrs.**

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 section–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. Limit state of torsional 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 perIS:456, reinforcement cover requirements and detailing.

Lab Component :

Singly Reinforced Beams C/S

Doubly Reinforced Beam C/S

(NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above beams using drafting software)

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

MODULE-2	**15 Hrs.**

Serviceability Limit State–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.

Lab Component:

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)

Self-study component:

Students shall visit an ongoing construction project site to observe the design and details 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.

Lab Component:

Slab–One way, Two way and One way continuous slab

Column(Square Rectangle and circular).

(NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above drawings)

Self-study component: Students shall visit an ongoing construction project site to observe the design details 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.

Lab Component:

Column footing-Column and footing(Square and Rectangle).

Staircase–Dog legged and open wells staircase

(NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above drawings)

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

Text Books:

1. Krishna Raju N., "Design of Reinforced Concrete Structures (IS 4562000)",3rdEd.CBS Publishers and Distributors, New Delhi (Ch.1,2,3,4)
2. Varghese,P.C.,"Limit State Design of Reinforced Concrete",2ndEd.– Prentice Hall of India, New Delhi -2008(Ch.5,6,7,8)

Reference Books:

1. B.C. Pumnia, Er.Ashok kumar jain and Arun k.jain, Reinforced Concrete design,10th edition, Lakshmi Publications, New Delhi.

2. Jain A K, Reinforced Concrete:Limit State Design 7th Edition, Nem Chand anBrothers, Roorkee.

3. S.Unnikrishna Pillai, Devdas Menon, Reinforced Concrete Design, 4th Edition, TMH, 2021

4. Karve SR and Shah VL,Limit State Theory And Design Of Reinforced Concrete–

Vidyarthi Prakashan, Pune.

5. N. Subramanaya, Design of RC Structures, Oxford IBH.

6. IS456–2000,SP– 24-1983,SP–16-1984, SP-34-1989 BIS Publications.

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1		**3**	**2**											
CO2		**3**				**2**								
CO3	**3**		**2**			**2**								
CO4		**3**												

Laboratory Rubrics

	Excellent	Very Good	Good	Average
Records. /20	•Comprehensive and well-organized records • All entries are accurate, complete, and clearly documented •Detailed observations and results are presented systematically (10)	•Good organization and mostly accurate entries •Minor errors or omissions in the records •Observations and results are presented, but lack some detail(8)	•Basic organization with several inaccuracies •Significant errors or omissions in the records •Observations and results are incomplete or unclear(6)	•Poorly organized records with many inaccuracies •Major errors or omissions throughout • Observations and results are largely missing or very unclear (4)
Procedure /10	•Procedure followed precisely as outlined in the manual •Clear, logical, and methodical execution of each step •No deviations or mistakes during the process(3)	•Procedure followed correctly with minor deviations •Logical execution with some small errors •Minor steps missed or executed incorrectly (2)	•Procedure partially followed with significant deviations •Execution lacks clarity and has noticeable errors •Several steps missed or executed incorrectly(1)	•Procedure not followed correctly •Execution is disorganized and unclear • Many steps missed or executed incorrectly(0)
Conduction /10	•Excellent execution of the experiment •All apparatus used correctly and safely •Results obtained are highly accurate and reliable(5)	•Good execution with minor errors •Apparatus used mostly correctly with some small mistakes •Results obtained are fairly accurate and reliable (3)	•Basic execution with noticeable errors •Apparatus used with several mistakes •Results obtained are somewhat accurate but less reliable(1)	•Poor execution with many errors •Apparatus used incorrectly or unsafely •Results obtained are inaccurate and unreliable(0)
Viva Voce /10	•Excellent understanding of the experiment and underlying concepts •Answers to questions are clear, concise, and correct •Demonstrates a high level of confidence and competence(2)	•Good understanding with minor gaps in knowledge •Answers to questions are mostly correct with minor errors •Demonstrates reasonable confidence and competence(1)	•Basic understanding with several gaps in knowledge •Answers to questions are partially correct with noticeable errors •Demonstrates limited confidence and competence(0.5)	•Poor understanding with many gaps in knowledge •Answers to questions are mostly incorrect or unclear •Demonstrates low confidence and competence(0)

Course Title	IRRIGATION ENGINEERING AND HYDRAULIC STRUCTURES		
Course Code	22CV602	(L-T-P)C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 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 course, 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,PO7,PO9	PSO2

MODULE – 1	8 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 ofCrops: 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	8 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	12 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	12 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.

Text Books:

1. S. K. Garg, "Irrigation Engineering and Hydraulic Structures", Khanna Publishers, New Delhi.
2. Punmia and PandeyLal, "Irrigation and Water Power Engineering" Lakshmi Publications, New Delhi.
3. K. R. Arora. "Irrigation, Water Power and Water Resources Engineering" Standard Publications, New Delhi.

Reference Books:

1. R. K. Sharma, "Text Book of Irrigation Engineering and Hydraulic Structures", Oxford and IBH, New Delhi.
2. P. N. Modi, "Irrigation, Water Resources and Water Power", Standard Book House, New Delhi.
3. Creager, Justin, Hinds. "Engineering for Dams (all volumes)" – Wiley India Publications.
4. Sathyanarayana Murthy "Design of Minor Irrigation & Canal structures"- New Age Publications, 1990

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**												**3**	
CO2	**3**												**3**	
CO3		**3**											**3**	
CO4						**2**	**2**		**2**					**3**

Course Title	APPLIED GEOTECHNICAL ENGINEERING		
Course Code	**22CV603**	**L-T-P**	**(3-0-0) 3**
Exam	**3 Hrs.**	**Hours/Week**	**3**
CIE+SEE	**50+50 Marks**	**Total Hours**	**40**

Course Objective:

1. 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, PO4, PO6	
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 and coulombs theories 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.

Text Books:

1. Venkataramaiah C, "Geotechnical Engineering", Revised third Ed., New Age International publishers, 2006.
2. Punmia, B.C. Ashok Kumar Jain &Arun Kumar Jain, "Soil Mechanics and Foundations", Laxmi

Publishing Co., New Delhi.2003.

Reference Books:

1. Bowles,I.E.,"FoundationAnalysisandDesigns",5thEd.,McGrawHillPublishing,NewYork,1996.
2. Murthy, V.N.S., " Principles of Soil Mechanics and Foundation Engineering", 5th Revised Ed., UBS Publishers and Distributors ltd, New Delhi,2001

MOOC Course:

1. NPTEL :: Civil Engineering - NOC:Geotechnical Engineering II Foundation Engineering.
2. Geotechnical Engineering-II - Course (nptel.ac.in).

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**			**2**		**2**								
CO2		**3**		**2**										
CO3	**3**	**2**		**2**										
CO4	**3**	**2**		**1**										

Course Title	MATRIX METHODS OF STRUCTURAL ANALYSIS		
Course Code	22CV651	L-T-P	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective: The main objective is to expand the student knowledge of the stiffness and flexibility methods studied in the basic structural analysis courses.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Discuss matrix operations relating to structural analysis by Flexibility method, Element Flexibility matrix, Principle of Contragradience, Force Transformation matrix, structure flexibility matrix and construction of structure flexibility matrix.	PO1,PO2, PO3	-
2.	Analysis of Pin jointed trusses using Force transformation matrix. Fundamentals of Stiffness Method: equivalent joint loads, Displacement transformation matrix, Member stiffness matrix, total or system stiffness matrix	PO2,PO3, PO4	-
3.	Analysis of frames by stiffness method and introduction to direct stiffness method.	PO2,PO3, PO4	-
4.	Analysis of trusses and continuous beams by displacement transformation method and direct stiffness method.	PO2,PO3, PO4	-

MODULE – 1	10Hrs

Introduction: Introduction to Flexibility method, Element Flexibility matrix, Principle of Contragradience, Force Transformation matrix, structure flexibility matrix, construction of structure flexibility matrix. Analysis of Pin jointed trusses using Force transformation matrix. **Fundamentals of Stiffness Method:** equivalent joint loads, Displacement transformation matrix, Member stiffness matrix, Total or system stiffness matrix.

Self-study component: The Students shall learn the available facilities for matrix operations on MATLAB Platform

MODULE – 2	10Hrs

Analysis of Trusses: Truss analysis by Stiffness method using Displacement transformation matrix.

Analysis of Continuous Beams by Stiffness method using Displacement transformation matrix.

Self-study component: The Students shall learn to write simple programmes for matrix formulation and solve the analysis problems of trusses and continuous beams.

MODULE -3	**10 Hrs.**

Analysis of Rigid Frames: with axially rigid members by Stiffness method using Displacement transformation matrix. **Introduction to Direct Stiffness Method:** Local and Global co-ordinate system, Transformation of variables, Transformation of member displacement matrix, Transformation of member force matrix, transformation of member stiffness matrix. Overall stiffness matrix, Boundary conditions and Computation of internal forces

Self-study component: The Student shall learn using direct stiffness method for the analysis of trusses and continuous beams.

MODULE -4	**10Hrs**

Analysis of Trusses: by Direct Stiffness Method.

Analysis of Continuous Beams: by Direct Stiffness Method.

Self-study component: The Students shall learn to write simple programmes using direct stiffness method for the analysis of trusses and continuous beams.

Text Books:

1. Reddy, C. S., "Basic Structural Analysis", Tata Mc Graw- Hill, 1996. (Ch. 2 to 8)
2. Rajashekharan. S and Sankarasubramanian G, "Computational Structural Mechanics", Prentice Hall of India , 2001. (Ch. 1,4,6,7 & 8)

Reference Books:

1. Weaver, W, J.M.Gere, "Matrix Analysis of Framed Structures", CBS publishers and distributors,1986.
2. Mukhopadhyay, "Matrix Finite Element, Computer and Structural Analysis",Oxford & IBW, 1984.

MOOC Course:

https://archive.nptel.ac.in/courses/105/105/105105180/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**1**	**3**	**2**											
CO2		**3**	**2**	**1**										
CO3		**3**	**2**	**1**										
CO4		**3**	**2**	**1**										

Course Title	STRUCTURAL DYNAMICS		
Course Code	22CV652	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 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 PO's	Mapping to PSO's
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	10Hrs.

Introduction; Laws of motion, D' Alembert's Principle, Stiffness of springs in series and parallel, Mass moment of inertia, Simple harmonic motion, Definition of vibration – Parts of a vibrating system –Degrees of freedom – Types of vibration. Free vibration; Undamped and damped free vibration of a single degree of freedom 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	10Hrs.

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

Text Books:

1. Mukhopadhya, M. "Vibrations, Dynamics and Structural Systems" Oxford IBH Publications, 2000 (Ch. 1, 2, &8)

2. Mario Paz, "Structural Dynamics" CBS Publishers, 2004 (Ch. 3, 4, 5, 6 &7)

Reference Books:

1. Clough & Penzien. "Dynamics of Structures" McGraw Hill Publishers2004

2. Chopra, A. K. (2019). "Dynamics of structures: Theory and applications to earthquake engineering." 5th Edition, Prentice Hall, NJ, USA

MOOC Course:

https://onlinecourses.nptel.ac.in/noc24_ce74/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**1**	**3**	**2**											
CO2		**3**	**2**	**1**										
CO3		**3**	**2**	**1**	**1**									
CO4		**3**	**2**	**1**	**1**									

Course Title	SOFT COMPUTING AND AUTOMATION IN CIVIL ENGINEERING		
Course Code	22CV653	(L-T-P) C	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective:

After completing this course, you will be able to learn:

- Fuzzy logic and its applications.
- Artificial neural networks and its applications.
- Solving single-objective optimization problems using GAs.
- Solving multi-objective optimization problems using Evolutionary algorithms (MOEAs).

Applications of soft computing to solve problems in varieties of application domains.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Fundamental concepts used in soft computing	PO1, PO2, PO6	-
2.	Understanding the concept of Fuzzy logic	PO2, PO4, PO6	-
3.	Learning fundamental concepts of Artificial Intelligence and Artificial Neural Networks concept and its application.	PO3, PO4, PO6	-
4.	Application of the Concept of multi-objective optimization problems	PO1, PO3, PO4	-

MODULE – 1	10 Hrs.

Introduction:

Concept of computing systems. "Soft" computing versus "Hard" computing. Characteristics of soft computing. Some applications of Soft computing techniques.

Self-study component : List and study various home appliances which involve soft computing and explain the methodology involved in each.

MODULE – 2	10Hrs.

Fuzzy logic:

Introduction to Fuzzy logic. Fuzzy sets and membership functions. Operations on Fuzzy sets, Fuzzy relations, rules, propositions, implications and inferences. Defuzzification techniques. Fuzzy logic controller design. Some applications of Fuzzy logic.

Self-study component: Study the real life application of fuzzy logic and list few.

MODULE -3	10 Hrs.

Artificial Intelligence:

Introduction, Long-Term Applications, Near-Term Applications, search techniques, games, vision, representation of knowledge, inference and process of proving theorems, natural language understanding. Biological neurons and it's working. Simulation of biological neurons to problem solving. Different ANNs architectures. Applications of ANNs to solve some real life problems.

Self-study component: Can AI guess your emotions?? –explore image classification, consider how facial features help us recognize emotions and train an AI to recognize these.

MODULE -4	10 Hrs.

MOOP:

Concept of multi-objective optimization problems (MOOPs) and issues of solving them.

Multi-Objective Evolutionary Algorithm (MOEA). Non-Pareto approaches to solve MOOPs. Pareto-based approaches to solve MOOPs. Some applications with MOEAs.

Self-study component: Students shall develop the excel programming spread sheets

to solve classical methods by method of calculus.

Text Books:

1) Randy L. Haupt and Sue Ellen Haupt (2004). Practical Genetic Algorithms. WILEY. Second Edition.

2) Eiben, A. E., & Smith, J. E. (2003). Introduction to evolutionary computing. Springer Science & Business Media.

Reference Books:

1. James A Anderson, (1995). An Introduction to Neural Networks. MIT Press

2. C. Mohan (2016). An introduction To Fuzzy set theory and fuzzy logic

MOOC/NPTEL Courses:

1. **10 ideas for using AI images in the classroom - YouTube**
2. **NPTEL : NOC: Introduction to Soft Computing (Computer Science and Engineering) (digimat.in)**
3. **Fuzzy Logic in Artificial Intelligence with Example | Artificial Intelligence - YouTube**

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**	**2**				**1**								
CO2		**3**		**2**		**1**								
CO3			**3**	**2**		**1**								
CO4	**3**	**3**	**3**	**2**		**1**								

Course Title	INDUSTRIAL WASTEWATER TREATMENT		
Course Code	22CV654	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	30

Course Objective: Apply principles of process optimization, resource recovery, and waste minimization to enhance the sustainability and efficiency of industrial wastewater treatment practices.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Analyse the concept of industrial quality and Impact of untreated effluents on the receiving environment	PO1.PO2	
2.	Analyze the different treatment options based on technical feasibility, cost effectiveness, and environmental impact.	PO1,PO2	
3.	To accomplish environmental audits effectively and recommended improvements to enhance environmental sustainability.	PO1,PO2	
4.	To assess the impact of industrial activities on the environment, economy, and society, considering sustainability and ethical implications	PO6,PO7	

MODULE – 1	10 Hrs.

Introduction: Difference between Domestic and Industrial Wastewater, Effect on Streams and on Municipal Sewage Treatment Plants**.** Stream quality, Dissolved Oxygen Sag curve in Stream, Streeter-Phelps formulation and problems, Stream Sampling, effluent and stream Standards and Legislation to Control Water Pollution.

Self-study component: The Students shall visit an industrial plant and learn about the effluent treatment method adopted by the industry. They shall try to witness the effect of flow of treated effluent on stream quality.

MODULE – 2	10Hrs.

Treatment Methods: Volume Reduction, Strength Reduction, Neutralization, Equalization and Proportioning. Removal of Inorganic suspended solids, Removal of Organic Solids.

Self-study component: The Students shall visit the effluent treatment plant and learn about the method of treatment adopted.

MODULE -3	**10 Hrs.**

Advanced Wastewater Treatment And Reuse: Chemical oxidation, Ozonation, wet air oxidation, evaporation, nutrient removal, management of RO rejects.

Process flow sheet showing origin/sources of waste water, Characteristics of waste, alternative treatment methods, disposal, reuse and recovery along with flow sheet. Effect of disposal on receiving bodies like sewers, streams and land: Cotton Textile Industry, Tanning Industry, Sugar Industry. Dairy Industry, pulp and paper industry.

Self-study component: The Students shall visit different industries and learn the specific method of effluent treatment adopted.

MODULE-4	**10 Hrs.**

Effects of waste addition on physical and chemical properties of soil, Bioremediation.

Environnmental Auditing- Introduction, Cost of pollution, Financial and managerial opportunities, tangible and intangible factors, waste disposal and water supply as a critical factor.

Self-study component: students shall learn wastewater treatment technologies, and sustainable water resource management practices.

Text Books:

1. Metcalf & Eddy , "Wastewater Engineering : Treatment, Disposal & Reuse" – Tata McGraw Hill Publishing Company, Third Ed. 1998 (Ch.2 & 4)

2.M.N Rao . A.K Datta' " Wastewater Treatment" Oxford & IBH Publishing Company Pvt Ltd. ISBN: 9878117120 Nemerow, N.L. "Industrial WasteWater Treatment." Edison–Wesley 1980 (Ch.1, 3, 5, 6, 7 & 8)

Reference Books:

1. Haward. S Peavy, Donald R Rowe, Environmental Engineering – George Tchnobanglous McGraw Hill International Ed. - 1987
2. Arceivala S.J. "Wastewater treatment for pollution control" 1990
3. Vivek Ranade, Vinay Bhandari , "Industrial Wastewater Treatment, Recycling and

Reuse". ISBN: 9780080999685

MOOC Course:

https://onlinecourses.nptel.ac.in/noc24_ce53/preview

Course Articulation Matrix

Course Outcomes	**Program Outcomes [POs]**													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	**3**	**2**												
CO2	**3**	**2**												
CO3	**3**	**2**												
CO4						**3**	**2**							

Course Title	GROUND IMPROVEMENT TECHNIQUES		
Course Code	22CV655	(L-T-P) C	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective:

1. To introduce the principles of treatment for soils.
2. To learn how to improve weak soils by modern ground improvement techniques.
3. To study the recent ground improvement techniques.
4. To study the role of soil reinforcement in soil stabilization.
5. To know the importance of geo-synthetics in ground improvement .

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Discuss the method of mechanical modification of the ground by various methods of compaction in ground improvement techniques.	PO1, PO2, PO4	
2.	Apply the concept of preloading technique by hydraulic modification of the ground improvement.	PO2, PO4	
3.	Review the basic principles of chemical modifications of the ground by incorporating cement, lime, flyash stabilization & other methods.	PO1, PO4, PO6	
4.	Illustrate the grouting technology and other advanced methods such as soil reinforcement, Crib walls, Gabions and Mattresses, ground anchors, rock bolts and soil nailing for ground improvement.	PO2, PO4, PO7	

MODULE – 1	10 Hrs.

Ground Improvement: Definition, Objectives of soil improvement, Classification of ground improvement techniques. Factors to be considered in the selection of the best soil improvement technique.

Mechanical Modification: Compaction- Mechanism of compaction. Densification. Engineering behaviour of compacted fine - grained soils. Static compaction, Dynamic compaction, Vibroflotation. Effect of compaction on engineering behaviour like compressibility, swelling and shrinkage, permeability, relative density, liquefaction potential. Field compaction – static, dynamic and vibratory type. Shallow and deep compaction

Self-study component: The Students shall visit nearby construction sites and observe the necessity of ground improvement techniques, problematic sites.

MODULE – 2	**10 Hrs.**

Hydraulic Modification: Objectives and techniques. Dewatering: Concept of dewatering, Interceptor ditches, Single - stage well points, Multi - stage well points and vacuum dewatering. Design of dewatering system.

Drainage & Preloading: Drainage of slopes, vertical drains, sand drains, prefabricated drains. Efficiency of vertical drains. Concept of preloading. Assessment of ground condition for preloading techniques. Methods of preloading techniques**.**

Self-study component: The Students shall collect the information and photos on hydraulic modification of soils, by visiting the various internet websites.

MODULE -3	**10 Hrs.**

Chemical Modification: Concept of chemical modification / stabilization, Construction techniques: Sandwich technique, Lime column techniques. Admixtures - Cement stabilization: soil - cement - water reactions. Factors affecting cement stabilization. Flyash stabilization: Flyash stabilization with lime, cement and aggregates. Soil modified with flyash and cement or lime. Lime stabilization: Soil - lime reactions. Engineering benefits of lime stabilization. Other chemicals like chlorides, hydroxides, lignin, hydrofluoric acid.

Self-study component: The Students shall collect the information and photos on chemical modification of soils, by visiting the various internet websites.

MODULE -4	**10 Hrs.**

Grouting: Introduction, characteristics of grouting, methods of grouting, Grouting techniques, Applications of grouting. Miscellaneous Methods (Only Concepts): Soil reinforcement. Ground improvement by confinement – Crib walls, Gabions and Mattresses. Ground anchors, Rock bolts and soil nailing, geo cells.

Self-study component: The Students shall collect the information and photos on grouting and miscellaneous methods of ground improvement by visiting the various internet websites.

Text Books:

1. Purushothama Raj. P, "Ground Improvement Techniques" Laxmi Publications, New Delhi, 1999.
2. Koerner.R.M., "Construction and Geotechnical Methods in Foundation Engineering" McGraw Hill Publ., New York, 1985.

Reference Books:

1. Manfred Hausmann, "Engineering Principles of Ground Modification", Mc Graw Hill Pub., New York, 1990.
2. Nelson, J. D and Miller, D. J., "Expansive Soils" John Wiley and Sons, 1992.

MOOC Course:

1. NPTEL :: Civil Engineering - NOC:Ground Improvement.
2. NPTEL :: Civil Engineering - NOC:Geosynthetics and Reinforced Soil Structures.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**		**1**										
CO2		**3**		**2**										
CO3	**3**			**1**		**2**								
CO4	**3**			**2**			**2**							

Course Title	TRAFFIC ENGINEERING		
Course Code	22CV656	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 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.

Text Books:

Kadiyali, L. R. (2019). "Traffic Engineering and Transport Planning". Khanna Publishers. ISBN: 978-8174092205

Khanna, S. K, Justo, C. E. G, and Veeraragavan A. (2019). Highway Engineering, Nem Chand and Bros, Roorkee. ISBN: 9788185204321, 8185240930

Reference Books:

Papacostas, C.A. (2001). "Fundamentals of Transportation Engineering", Prentice-Hall of India Pvt. Ltd., New Delhi. ISBN: 0133448703

Kumar, R. S. (2019). "Introduction to Traffic Engineering", University Press. ISBN: 9386235471

Partha Chakroborty and Animesh Das (2011), 'Principles of Transportation Engineering', Prentice Hall (India), New Delhi, ISBN: 9788120353459

Pignataro, Louis; 'Traffic Engineering-Theory and Practice', John Wiley. Prentice Hall, ISBN: 0139262202.

MOOC Course:

Introduction to Multimodal Urban Transportation Systems

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

Course Articulation Matrix

Course Outcomes	**Program Outcomes [POs]**													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**	**1**											
CO2	**3**	**2**												
CO3	**3**	**2**	**1**											
CO4	**3**		**2**											

Course Title	RURAL WATER SUPPLY & SANITATION		
Course Code	22CV657	**(L-T-P) C**	(3-0-0)3
Exam	3 Hrs	**Hours / Week**	3
CIE+SEE	**50+50 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: Upon completion of the course, students shall be able to

Sl. No.	Course Outcomes	pping to POs	Mapping to PSOs
CO1	Discuss the importance of village community and need for protected water supply	PO1, PO6, PO7	-
CO2	Describe the need and methods of water treatment and rural sanitation	PO1, PO6, PO7	-
CO3	Assess different methods of rainwater harvesting and refuse disposal	PO1, PO6, PO7	-
CO4	Discuss various methods of controlling communicable diseases and milk sanitation	PO1, PO6, PO7	-

Course Contents:

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 .

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

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

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 village and study different sanitation methods adopted and shall submit a report of their observations under

self-study components.

Text Books:

1. Salveto “Environmental Sanitation” Mc Graw Hill, II Edition, 1970 Steel.E.W.
2. “Water Supply and Sewerage.” Mc Graw Hill, V Edition, 1985

Reference Books:

1. Gourishekar Gosh “Water Supply in Rural India : Policy and Programme” APH Publishing Corporation- 2006
2. Allan Greenwell “Rural Water Supply” Bibliolife publishers

MOOC/NPTEL Courses:

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

Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2		PSO 2
CO 1	3						2									
CO 2						2	3									
CO 3	2						3									
CO 4	3						2									

Course Title	ENVIRONMENTAL IMPACT ASSESSMENT		
Course Code	**22CV658**	**(L-T-P) C**	**(3-0-0) 3**
Exam	**3 Hrs.**	**Hours/Week**	**3**
CIE+SEE	**50+50 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	**10Hrs.**

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.

The EIA process, Contents of EIA. 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	**10Hrs.**

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.

Text Books:

1. Rau and Wooten,(1981),"Environmental Impact Assessment "Handbook.
2. JainR.K.,UrbanL.V.,StaceyG.S.,(1977),"EnvironmentalImpactAnalysis
3. New Dimension in Decision Making", Van Nostr and Reinhold Co.

Reference Books:

1. Clark B.C. Bisett and TomlinsanP, (1985), "Perspective on Environmental Impact Assessment", Allied Publishers.
2. Canter L.,(1995),"Environmental Impact Assessment", McGraw Hill.
3. Journals-Science Direct, acs.org
4. EIA notifications and Publications, MoEF, GoI
5. EPA Act(2006),"Amendments and Clarifications

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3					1	2							
CO2	1					2	3							
CO3	2					1	3							
CO4	2					3	1							
	2					2	3							

Course Title	THEORY OF ELASTICITY		
Course Code	22CV659	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 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:

#	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 and the	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

I**ntroduction 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. **Axisymmetric 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***	

Text Books:

1.Timoshenko S P and Goodier.J.N. " Theory of Elasticity" International Students' Education McGraw Hill Book Co Inc. New Delhi, Third edition 2007[Ch.1,2,3,4,5,6,7,8]- 2015

2.Sadhu Singh "Theory of Elasticity". Khanna Publishers, New Delhi, 2007 [Ch.2,3,4,5,6,7) – 2015

Reference Books:

1.Valliappan.C" Continuum Mechanics Fundamentals" Oxford and IBH, Publishing Co.Ltd, New Delhi – 2003

2.Srinath.L.S. " Advanced Mechanics of Solids" Tata McGraw Hill Publications Co., Ltd., New Delhi-Third edition- 2021

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**	**3**		**1**										
CO2	**2**	**3**		**1**										
CO3	**2**	**3**		**1**										
CO4	**2**	**3**		**1**										

Course Title	URBAN TRANSPORTATION PLANNING		
Course Code	22CV660	L-T-P	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective: This Course will enable the students to

1. Provide knowledge on Urban Transportation Planning Process in a systematic way.

2. Understand the importance of Evaluation: Need for Evaluation , Transport Planning for Small and Medium Sized Cities.

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 transport planning process and various techniques adopted to conduct transportation survey, to analyze and forecast future condition of the study area.	PO1, PO2, PO4	
2.	Analyze the factors governing trip generation by adopting statistical tools to understand the problem & different methods of trip distribution.	PO1, PO2, PO4	
3.	Analyze the general principles of traffic assignment and role of modal split in transport planning process.	PO1, PO2, PO4	
4.	Apply the methods of evaluation process in transport planning and to analyse the transport planning process for small and medium sized cities.	PO1, PO2, PO4	

MODULE – 1	10Hrs.

Transport Planning Process – Inter-dependence of the land use and traffic. Systems approach to transport planning. Stages in transport planning. Survey and analysis of existing conditions. Forecast, Analysis of future conditions and plan Synthesis, evaluation. Programme adoption and Implementation. **Transportation Survey**-Introduction, Definition of the Study Area, Zoning, Types of Surveys- Conventional and modern techniques.

Self-study component: The students shall learn various transportation survey techniques and to adopt the same in the smaller area of the city.

MODULE – 2	10 Hrs.

Trip Generation – Trip purpose – Factors governing Trip generation and Attraction on routes, Multiple linear regression analysis – Assumptions validity in trip generation studies. Aggregated and disaggregated analysis. Criteria for evaluation of Regression equations, category analysis – Assumptions. Critical appraisal of category analysis techniques. Trip Distribution: Method of trip distribution, Uniform factor method, Average factor method – Fratar method. Furness method, criticism of growth factor method, Gravity model, Calibration of gravity model, Tanner's model, Opportunity model with relevant numerical problems.

Self-study component: The students shall learn the trip generation and trip Distribution methods and same to be adopted in the some ward of the city.

MODULE -3	**10 Hrs.**

Traffic Assignment: General principles – Assignment techniques – All or nothing assignment – Multiple route assignment – capacity resistant assignment – Smock method –Diversion curve with numerical examples.

Modal Split - Factors affecting modal split – Modal split in transportation planning process.

Self-study component: The students shall learn traffic assignment techniques and importance of modal split and then adopt the same to the town/urban area.

MODULE -4	**10 Hrs.**

Evaluation: Need for Evaluation, Several Plans to be Formulated, Testing, Considerations in Evaluation, Transport Planning for Small and Medium Sized Cities: Introduction, Difficulties in Transport Planning for Small and Medium Cities.

Self-study component: The students shall visit important roads and understand the available infrastructural facilities in the urban area. The student shall also visit Karnataka State Road Transport Corporation Limited and to study the public transport buses and implementation of the schedules in the urban area.

Text Books:

1. C. A. O'Flaherty, Transport Planning and Traffic Engineering, Elsevier Publishers, New Delhi, 2006. (Module-4).

2. Kadiyali.L.R. Traffic Engineering and Transport Planning, Ninth Edition, Khanna Publishers, New Delhi, 2017. (Module-1, 2 and 3).

Reference Books:

1. Black John, " Urban Transport planning", Croom Helm ltd, Landon 3rd edition, 2005.

2. DilipHalder, Studies in Urban Transport, Bookwell, New Delhi, 2007.

3. Hutchison B. G, Principles of Urban Transport Systems Planning, McGraw-Hill Book Company, 1974.

4. Peter Bonsall, Quasim Dalvi& Peter J Hills, Urban Transportation Planning: Current Themes and Future Prospects, Abacus Press, New Jersey, 1977.

MOOC Course:

1. Urban Transport Planning - Dr. V Thamizh Arasan, Professor , Department of Civil Engineering, IIT Madras;
2. Urban Transportation Planning - web course - Dr. M Parida, Professor, Department of Civil Engineering, IIT Roorkee.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**	**2**		**1**										
CO2	**3**	**2**		**1**										
CO3	**3**	**2**		**1**										
CO4	**3**	**2**		**1**										

Course Title	GROUNDWATER HYDRAULICS		
Course Code	22CV661	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 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.
- Utilize field methods and data analysis techniques to interpret hydro-geological data, communicate findings effectively through reports and presentations, and collaborate with peers and professionals in the field.

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 importance of groundwater resource management to develop and implement effective utilization, planning, and conservation strategies.	PO1	PSO 1
2.	Apply the aquifer and flow characteristics to assess groundwater availability, movement and exploration.	PO1	PSO 1
3.	Analyze aquifer recharge processes and groundwater utilization to develop knowledge of resource management.	PO2	PSO 1
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	PO7, PO9, PO12	PSO 2

MODULE – 1	10Hrs.

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 groundwater withdrawals.

Self-Study Component: Students shall collect the groundwater 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 the 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.**

Groundwater Explorations: Seismic method, Electrical resistivity method, Borehole geophysical techniques- Electrical logging, Radio wave logging, Induction logging, Sonic logging and Fluid logging.

Groundwater 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.

Text Books:

1. Raghunath H.M "Ground Water" 4th Edition, New Age International Publishers, 2008
2. David K.Todd. Larry W.Mays "Groundwater Hydrology" 3rd Edition, Wiley India Pvt. Ltd, New Delhi.

Reference Books:

1. Jaya Rami Reddy P "Hydrology" 3rd Edition, Laxmi Publications Pvt. Ltd. New Delhi.
2. Rastogi A. K. "Numerical Groundwater Hydrology Hardcover" Penram International Publishing. (Ind) Pvt Ltd, Mumbai, 2008.

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**2**												**3**	
CO2	**3**												**3**	
CO3		**3**											**3**	
CO4							**2**		**2**			**2**		**3**

Course Title	MODERN CONSTRUCTION METHODS AND MECHANIZATION		
Course Code	22CV662	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 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 imparts knowledge about the application of these equipment for performing various construction activities in projects.

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

#	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	10Hrs.

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	10Hrs.

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 repor*t**

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 – launching and pushing of box decks

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, False work design, Effects of wind load, Foundation and soil on false work 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 false work

Self-study component : Students shall collect the information on types of formwork used in India

Reference Books:

1. Allen E, Iano, J, Fundamentals of Building Construction subscription E Book, Material and Method, John Wiley and Sons, 2011.
2. Cameron K. Andres, Ronald C. Smith, Principles and Practices of Commercial Construction, 8 th Ed., Prentice Hall, 2009.
3. Austin, C.K., Formwork for concrete, Cleaver - Hume Press Ltd., London, 1996
4. Robert L. Peurifoy and Garold D. Oberiender, Formwork for Concrete Structures, McGraw-Hill, 1996

MOOC Course:

https://onlinecourses.nptel.ac.in/noc21_ce21/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**													
CO2	**3**													
CO3		**3**												
CO4						**2**			**2**	**2**				

Course Title	ENGINEERING SEISMOLOGY		
Course Code	22OECV661	L-T-P	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective:

To learn different seismic hazard, global seismicity and risk.

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 concept of earthquake, Ground motion parameters and Seismic Zonation.	PO1	
2.	Interpret different types ground motion simulation models and there relationships.	PO2	
3.	Comprehend the concept of Intensity and Magnitude; different earthquake scales.	PO1, PO2	
4.	Analyze seismic optional of the region and better way of estimating the future seismic hazard.	PO1, PO2	

MODULE – 1	10 Hrs.

Seismology:

Introduction to seismology, Earthquake hazard: Mitigation and preparedness, Different Earthquake Hazards, Earthquake Terminologies, plate tectonics, Faults; Seismic Sources, Types of Earthquakes; Causes of Earthquakes, wave propagation, seismic instrumentation, Seismic Sensors, Seismic Instrumentation in India.

Self - study component: Students shall study the various earthquake around the world.

MODULE – 2	10 Hrs.

Ground motion parameters:

Frequency Domain Characteristics; Response Spectrum, Fourier Spectrum, Seismic Source Parameters, Time history; response Spectra; Stochastic models, Ground Motion Simulation models, Prediction Relationships, earthquake prediction, and seismic gap.

Self-study component: Students shall understand the importance of D-V-A plot.

MODULE -3	**10 Hrs.**

Intensity scales of Earthquake:

Road Damage Intensity Scale; and Seismic Vulnerability assessment, Quantification of Earthquake (magnitude), Energy released due to earthquakes, Interpretation of Earthquake records, Time Domain Parameters earthquake intensity and magnitude,

Self-study component: Students shall collect the information on damages due to earthquake in India

MODULE -4	**10 Hrs.**

Seismic Zonation:

Seismic zonation, Seismic zonation of India, Global Earthquake risk map, Zonation Map of India, SeismoTectonics of India, Seismic hazard analysis, Seismic Study area and Seismotectonic Map, Seismic Data Collection,

Self-study component: Students shall collect the information on recent tectonic movement.

Text Books:

1. Jain S K (Guest Editor), Earthquake Engineering : An ICJ Compilation, Research & Consultancy Directorate, The ACC Ltd, Thane, 2004
2. Chopra A.K, "Dynamics of Structures", Prentice Hall,India.
3. S.K. Duggal "Earthquake Resistant Design of Concrete Structures", Oxford university press, NewDelhi.

Reference Books:

1. Advances in Indian Earthquake Engineering and Seismology: Contributions in Honour of Jai Krishna
2. Ghosh S.K, "Earthquake Resistant Design of Concrete Structures", SDCPL-R&D center, New Delhi.
3. IITK-GSDMA guidelines for seismic design. National Information Center of Earthquake Engineering
4. Murty, C. V. R. (2005). IITK-BMTPC Earthquake Tips Learning Earthquake Design and

Construction. Indian Institute of Technology

MOOC Course:

1. https://archive.nptel.ac.in/courses/105/108/105108204/#
2. https://archive.nptel.ac.in/courses/105/104/105104200/.

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**													
CO2		**3**												
CO3	**3**	**2**												
CO4	**3**	**2**												

Course Title	WATER SUPPLY AND SANITATION		
Course Code	22OECV662	(L-T-P) C	(3-0-0)3
Exam	3 Hrs	Hours / Week	3
CIE+SEE	50+50 Marks	Total hours	40

Course Objective:

to provide students with a scientific and technical background in air pollution monitoring, pollution control technologies and environmental management.

Course Outcomes: Upon completion of the course, students shall be able to

Sl. No.	Course Outcomes	Mapping to POs	pping to PSOs
CO1	Estimate average and peak water demand for a community.	PO1, PO2	-
CO2	Evaluate water quality and plan suitable treatment system	PO1, PO7	-
CO3	Discuss various treatment methods available for treating drinking water	PO1, PO7	-
CO4	Evaluate wastewater quality and design suitable conveyance systems for sewage and design a comprehensive wastewater treatment system	PO1, PO7	PSO1

Course Contents:

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 particular source of water.

MODULE –2	10 Hrs.

Quality of Water: Concept of safe water: wholesomeness, palatability and potable. 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 and types of aerators.

MODULE –3	**10 Hrs.**

Sedimentation: Theory, settling tanks, types and design. **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.

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

Analysis of Sewage: Physical, chemical, and biological characteristics. **Treatment of Sewage**: Flow diagram of municipal sewage treatment plant

Self-study: Students shall visit nearby water treatment plant and study various treatment techniques adopted.

Student 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.

Text Books:

1. Water Supply Engineering: Environmental Engineering - Vol. I – 2017 Santosh Kumar Garg, Khanna Publisher, ISBN-10: 9788174091208
2. Punmia B.C. and Ashok Kumar Jain, "Environmental Engineering- I",Arihant Publications
3. S. K. Garg ―Environmental Engineering: Sewage Disposal and Air Po llution Engineering
4. (Volume - 2), 33 Edition, 2015, Khanna Publishers, ISBN: 9788174092304, 8174092307.
5. Punmia B. C. and Jain A., "Environmental Engineering-II, ArihantPublications, 1995 (Ch. 1 & 2)

Reference Books:

1. Hammer and Hammer, “Water Technology”, Mc Graw Hill Publications Howard S. Peavy, Donald R. Rowe. George Tchobanoglous, “Environmental Engineering” - McGraw Hill International Ed. ISBN-10: 9351340260

2. CPHEEO Manual on water supply and treatment engineering, Ministry of Urban Development, Government of India, New Delhi, 3rd Edition, 2018, Akalank Publications; ISBN-10: 8176393819

3. Waste Water Treatment, Disposal and Reuse -Metcalf and Eddy inc, Tata McGraw Hill

Publications (2008 Edition), ISBN-10: 0071008241, ISBN-13: 978-0071008242

4. Wastewater treatment Concepts and Design Approach by Karia G.L., C hritian R.A. Second Edition, 2013. Prentice Hall India Private limited, ISBN-10: 8120328604, ISBN-13: 978-8120328600.

MOOC/NPTEL Courses:

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

Course Articulation Matrix

	PO 1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO 9	PO1 0	PO11	PO1 2	PSO1	PSO2
CO1	2	3												
CO2	2						3							
CO3	2						3							
CO4	3						2						3	

Course Title	COMPOSITES AND SMART MATERIALS		
Course Code	**22OECV663**	**(L-T-P)C**	**(3-0-0)3**
Exam	**3 Hrs.**	**Hours/Week**	**3**
CIE+SEE	**50+50 Marks**	**Total Hours**	**40**

Course Objective: The course aims to analyze the environmental impact on materials, study various composite characteristics and to study various types of smart materials used in engineering application.

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 fundamental properties, manufacturing processes, and applications across various industries for different types of composites	PO2, PO3	
2.	Perceive different classes of ceramic and polymeric smart materials; development of actuators and sensors and their integration into a smart structure	PO2, PO3	
3.	Apply the principles to various fields like automobile, space, medical, automotive, building construction, etc	PO2, PO3	
4.	Design of embedded & surface mounted, piezoelectric devices	PO1, PO2, PO3	

MODULE – 1	**10 Hrs.**

Introduction to Composite materials: Classifications and applications of fibers, volume fraction and load distribution among constituents, minimum & critical volume fraction, compliance & stiffness matrices.

Self-study component: Student shall gain knowledge about the innovative composite materials and their applications in civil engineering domain.

MODULE – 2	**10 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: Student 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.

Self-study component: Student 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, piezoelectric coefficients, phase transition, piezoelectric constitutive relation.

Self-study component: Student shall learn about self-healing materials used in aircraft industry etc.

Text Books:

1. Robart M Jones, "Mechanic of Composite Materials", McGraw Hill Publishing Co, ISBN 10: 0891164901 ISBN, 13: 9780891164906, Wonder book seller , Frederick, USA.
2. Bhagwan D Aggarwal and Lawrence J Broutman, "Analysis and Performance of Fiber Composites", ISBN: 978-1-119-38997-2, John Willy and Sons, NewYork.

Reference Books:

1. Crawley, E and de Luis, J., "Use of piezoelectric actuators as elements of intelligent structures", AIAA Journal, Vol. 25 No 10, Oct 1987, PP 1373-1385.
2. Crawley, E and Anderson, E., "Detailed models of Piezoceramic actuation of beams", Proc. of the 30th AIAA /ASME/ASCE/AHS/ASC- Structural dynamics and material conference, AIAA Washington DC, April 1989.
3. Lecture notes on "Smart Structures", by Inderjith Chopra, Department of Aerospace Engg., University of Maryland.

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		**3**	**2**											
CO2		**3**	**2**											
CO3		**2**	**1**											
CO4	**3**	**2**	**1**											

Course Title	URBAN DESIGN AND REGENERATION		
Course Code	22OECV664	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective:

The course in Urban Design and Regeneration, aims to explore sustainable urban regeneration processes considering all dimensions (including environmental and socioeconomic) with an integrated and multidisciplinary framework approach.

This allows for planning, assessing, and evaluating urban regeneration processes and projects considering the different perspectives of local authorities, real estate and financial operators, investors, and other key stakeholders.

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Discuss the strategies involved in Urban regeneration.	PO6, PO7	
2.	Interpret the various planning tools regarding the urban assets	PO6, PO8	
3.	Review the public and private sector roles and relationships and project phasing in the implementation of the urban regeneration projects	PO7, PO8	
4.	Report on the translation of the concepts of urban regeneration in a case study project.	PO9,PO10, PO12	

MODULE – 1	10Hrs

Definition, the three orientations, the interrelated groups of spaces in the domain of urban design, the eight elements of urban design. The process of urban regeneration projects. The fundamental first phase– Scoping: The key components, macro and microlevel scoping. The Planning Process: defining the planning framework, master planning, developing design standards, Setting the scene, defining the implementation process and Institutional arrangements, partnering arrangements with the private sector, defining early wins. The Financial tools: Municipal finance tools, land specific financial and regulatory tools for public land. Financial tools for private lands (non capital markets and capital markets), Regulatory tools for private lands (policy and fiscal).

Self-study component: Study of the Review of the Book "The Urban Design Process" by Hamid Shirvani.

MODULE – 2	10Hrs
Urban assets – First asset land: ownership regimes, tools for land assembly (voluntary and involuntary), land tools for public asset management, land regulatory frameworks. Second asset community: Tools for community participation, charrettes, using technology for public participation.. Third asset: Environment: Site assessment, site investigation, EIA and site remediation plan. ***Self-study component: Examine the tools for public participation in case studies from the world Bank report Regenerating Urban Land: A Practitioner's Guide to Leveraging Private Investment.***	
MODULE -3	**10 Hrs.**
Social equity aspects of regeneration. Interventions for a more socially equitable regeneration project. The potential undesirable impacts of urban regeneration: Gentrification and Loss of social capital. Tools to mitigate the undesirable social impacts: resettlement, principle of minimizing displacement, compensation, Inclusionary zoning and housing vouchers. ***Self-study component: Reading of the book "Uses of Disorder" by Richard Senett and short review writing on any one chapter of the book***.	
MODULE -4	**10 Hrs.**
Implementation Phase. Political leadership, Public and private sectors roles and responsibilities, phases of implementation, Framework for assessing and mitigating risks : political, financial, technical environmental, Land ownership and regulation, stakeholders, fiduciary and commercial risks. The parameters that influence the urban regeneration strategy: Landuse and zoning, historical preservation, environmental features, open spaces, building form, people participation, economic base, infrastructure and transportation networks, urban planning policies and political leadership. case study for each parameter ***Self-study component: Collect information and read about Government of India strategies like Swachh Bharat Mission - Urban (SBM-U), Pradhan Mantri Awas Yojana - Urban (PMAY-U), Smart Cities Mission (SCM), Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Deendayal Antyodaya Yojana - National Urban Livelihoods Mission (DAY-NULM) and Heritage City Development and Augmentation Yojana (HRIDAY)***	
Text Books: 1. Hamid Shirvani, "The Urban Design Process" Van Nostrand Reinhold, 1985 1. Amirtahmasebi, Rana, Mariana Orloff, Sameh Wahba, and Andrew Altman. Regenerating Urban Land: A Practitioner's Guide to Leveraging Private Investment. 2016. Urban Development Series. Washington, DC: World Bank. doi: 10.1596/978-1-4648-0473-1. License: Creative Commons Attribution CC BY 3.0 IGO	

Reference Books:

1. Urban Regeneration, A Handbook, edited by Peter Roberts and Hugh Skyes. Sage Publications Limited 2008.

2. Ministry of Housing and Urban Affairs, Government of India, “Transforming Urban Landscape” 2014-19

MOOC Course:

1. https://onlinecourses.nptel.ac.in/noc21_ar12/preview

2. https://archive.nptel.ac.in/courses/124/107/124107158/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1						**3**	**2**							
CO2						**2**		**1**						
CO3							**2**	**1**				**1**		
CO4									**3**	**2**		**1**		

Course Title	Hazardous Waste Management		
Course Code	22OECV665	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 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	10 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 disposa land transport.

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

MODULE – 2	10Hrs.

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	**10 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.

Text Books:

1. Pichtel, J. (2014). Waste Management Practices: Municipal, Hazardous, and Industrial. CRC Press.
2. La Grega, M. D., Buckingham, P. L., & Evans, J. C. (2010). Hazardous Waste Management. WavelandPress.

Reference Books:

1. Bhat, S. (2019). Handbook on Chemicals and Hazardous waste manageWaste Management and Handling in India. Ministry of Environment, Forests & Climate ChangeNew Delhi & National Law School of India University,Bengaluru

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

MOOC Course:

https://archive.nptel.ac.in/content/syllabus_pdf/105106056.pdf

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**3**	**2**												
CO2	**3**	**2**												
CO3	**3**	**2**												
CO4	**3**					**2**								

Course Title	SUSTAINABLE DEVELOPMENT GOALS		
Course Code	22OECV666	(L-T-P) C	(3-0-0) 3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective:

1. The course seeks to build an interdisciplinary perspective on understanding sustainable development concerns and challenges..

2. This course familiarizes students with current debates and perspectives in analyzing constraints and opportunities for sustainable development

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Apply the basic concept of Sustainable Development (SD), the environmental, social and economic dimensions	PO1, PO2, PO6,PO7	
2.	Analysis of factors that support to achieve sustainability and resilience in an individual level and in a community	PO2, PO6, PO7	
3.	Develop an encompassing understanding of sustainability issues	PO1, PO2, PO6	
4.	Categorize the embedment of sustainability issues in environmental, societal, and economic systems	PO1, PO6, PO7	

MODULE – 1	10 Hrs.

Introduction Glimpse into History and Current practices - Broad introduction to SD - its importance, need, impact and implications; definition coined; Changing Perspectives Definitions· & Principles of Sustainable Development Goals Millennium Development Goals: Status (global and Indian),· Inclusive Growth and Poverty Reduction, Impact on approach to development policy and practice in India, future directions.

Self-study component: Explore India's National Action Plan on Climate Change, Swachh Bharat Abhiyan, and National Rural Employment Guarantee Act (NREGA) to grasp their objectives and implementation methods.

MODULE – 2	10 Hrs.

Poverty, Hunger, Good Health and Well-being Eradication of poverty and hunger to help all societies achieve a higher quality of life Gender Equality, Reduced Inequalities Reduce inequalities worldwide Clean Water and Sanitation, Affordable and Clean Energy Universal access to basic essential services including clean drinking water, hygiene and sanitation, and safe renewable energy

Self-study component:Identify local challenges in India that correspond to specific Sustainable Development Goals (SDGs) and examine how governmental and grassroots initiatives address these issues.

MODULE -3	**10 Hrs**

Quality Education, Decent Work and Economic Growth ,Universal access to inclusive education and decent work to support fair and socially just economic opportunities Industry, Innovation, and Infrastructure; Sustainable Cities and Communities; Responsible Consumption and Production

ovative solutions and resilient infrastructure to enable societies to produce and consume in a more stainable way Climate Action, Life Below Water, Life on Land The protection of human and non-man life by combating climate change and safeguarding oceans and terrestrial habitats including inland face water Peace, Justice, and Strong Institutions; Partnerships for Goals Collaboration between all ciety partners and stakeholders to create a world of peace and justice for all

Self-study component:Explore Karnataka's initiatives aimed at achieving Sustainable Development Goals.

MODULE -4	**10 Hrs.**

Implementing the SDGs Solutions and best practices at the individual, local, national, and international level– Monitoring, Evaluation, Reporting Measuring SDG success through indicators, monitoring, evaluation, and reporting– Beyond Sustainability to Radical Transformation The course will close with an introduction to taking the SDGs to the next level – changing world-views and perspective through radical transformation and thinking beyond sustainability

Self-study component: Investigate successful state-level projects like Kerala's healthcare model and community-driven efforts such as the Sunderbans mangrove conservation project to learn about effective strategies for achieving SDGs

Text Books:

1. Hazell P. and Diao X. (2005) The Role of Agriculture and Small Farms in Economic Development, Washington, D.C.: International Food Policy Research Institute.
2. Sachs J. (2006) The End of Poverty: Economic Possibilities for Our Time, Penguin (Chapters 1-4, 8, 14-18).

Reference Books:

1. Franco, I.B. and Tracey, J. (2019), "Community capacity-building for sustainable development: Effectively striving towards achieving local community sustainability targets", International Journal of Sustainability in Higher Education, Vol. 20 No. 4, pp. 691-725

2. Our Common Journey: A Transition Toward Sustainability. National Academy Press, Washington D.C. Soubbotina, T. P. 2004.
3. Elliott, Jennifer. 2012 An Introduction to Sustainable Development. 4th Ed. Routledge, London.4. National Building Code (NBC), Bureau of Indian Standards

MOOC Course:

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**	**2**				**2**								
CO2		**3**				**2**	**3**							
CO3	**3**	**2**				**2**								
CO4	**3**					**2**	**3**							

Course Title	RAILWAY ENGINEERING		
Course Code	22OECV667	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective:

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 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 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.**

Geometric Design of Track: Gradient–necessity, ruling gradient, pusher gradient, momentum gradient, gradients in station yards. Superelevation– cant deficiency and negative cant – numerical examples.

Points and Crossings: Types of switches, types of crossings, Classification of Crossing According to Manufacturing Process, Turnouts – common layouts – Inspection and maintenance

Self-study component:

Students shall visit nearby Railway station and discuss with the railway staff regarding track construction procedure, type of gradient, speed of train, prepare a report and submit.

MODULE -4	**10 Hrs.**

Maintenance of track: Necessity, Advantages & types. Safety in railways – Railway accidents, Classifications, Causes and prevention. Emergency methods of restoring railway traffic. Nationalization of railways, advantages & disadvantages.

Railway expenses, rates & fares: Characteristics, measures to reduce expenses & railway budget

Self-study component:

Students shall visit nearby Railway station and discuss with the railway staff regarding track maintenance, steps taken towards modernization prepare a report and submit.

Text Books:

1. SC Saxena and Arora "Railway Engineering" Dhanpath Rai and Sons, New Delhi-2015. ISBN:978–9383182923
2. M M Agarwal,"Indian RailwayTrack "Oxford Publications,Bombay–2018. ISBN-13:978-0-19-568779-8.

Reference Books:

Rangawala, "Principles of Railway Engineering" Charotar Publishing House, New Delhi–2017.ISBN:8192869253.

Sathish Chandra,"Railway Engineering"Oxford University Press,New Delhi–2013.ISBN-10:0-19-

568779-5.

Amith Gupta, “Railway Engineering” Standard Publishers Distributors, NewDelhi– .2015.ISBN:81–8014–011–3.

MOOC Course:

1. Urban Transportation Systems Planning,

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

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	2												
CO2	3	2	2											
CO3	3	2	2											
CO 4	3	2												

Course Title	REMOTE SENSING & GIS		
Course Code	**22OECV668**	**(L-T-P) C**	**(3-0-0) 3**
Exam	**3 Hrs.**	**Hours/Week**	**3**
CIE+SEE	**50+50 Marks**	**Total Hours**	**40**

Course Objective: To develop knowledge on RS & 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 PO's	Mapping to PSO's
1.	Comprehend remote sensing entails understanding of Energy interactions.	PO1	-
2.	Apply remote sensing in data collection and analysis through different types of sensors & platforms	PO1	-
3.	Analyze spatial data in GIS involves managing, analyzing, and visualizing spatial data	PO2	-
4.	Develop the comprehensive report on different types of currently working satellites and their uses.	PO9,PO10	-

MODULE – 1	**10 Hrs.**

Remote Sensing:

Basic concept of Remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, and vegetation), Resolution, image registration and Image and False color composite, elements of visual interpretation techniques.

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 Data base: Geographic data: Spatial and non-spatial; Data models: Raster and vector; Database Management System (DBMS): Geo-database. Data Structures: Relational, hierarchical and network; Data input and scale: Nature and Source of data, 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 world and their working.

Text Books:

1. Lillesand, Kiefer, Chipman, “Remote Sensing and Image Interpretation”, Wiley2011.
2. Basudeb Bhatta “Remote sensing and GIS” Oxford university Press, New Delhi, India,2021
3. Narayan Panigrahi, “Geographical Information Science”, and ISBN 10: 8173716285 / ISBN 13:

9788173716287, University Press2008.

4. Kang – T surg Chang, “Introduction to Geographic Information System”. Tata McGraw Hill Education Private Limited2015.

Reference Books:

1.Anji Reddy M., “Remote sensing and Geographical information system”, B. S. Publications2008.

2.S Kumar,“Basics of remote sensing & GIS”, Laxmi publications 2005

3. 2. John R. Jensen, “Remote sensing of the environment”, an earth resources perspective–2nd edition– by Pearson Education2007

4. 1. Chor Pang Lo and Albert K.W Yeung, “Concepts & Techniques of GIS”, PHI,2006

MOOC Course:

https://onlinecourses.nptel.ac.in/noc22_ce84/preview

https://www.iirs.gov.in/pgdiploma

https://archive.nptel.ac.in/courses/105/103/105103193/

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	**3**													
CO2	**3**													
CO3		**3**												
CO4									**3**	**2**				

Course Title	ADVANCED CONSTRUCTION MATERIALS AND GREEN BUILDINGS		
Course Code	22OECV669	(L-T-P) C	(3-0-0)3
Exam	3 Hrs.	Hours/Week	3
CIE+SEE	50+50 Marks	Total Hours	40

Course Objective:

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

#	Course Outcomes	Mapping to PO's	Mapping to PSO's
1.	Describe the green building materials and advanced energy-efficient design techniques with their environmental impacts.	PO1	
2.	efficient design techniques with their environmental impacts Investigate feasibility and benefits of industrial waste products, and develop sustainable integration strategies.	PO7	
3.	Apply advanced concrete technologies to optimize durability, sustainability, and efficiency in diverse construction applications.	PO1,PO7	
4.	Develop practical knowledge and observation skills for rating of green building using IGBC and LEED .	PO8,PO9,PO12	

MODULE – 1	12Hrs.

Introduction: Energy in building materials, Environmental issues concerned to building materials, Embodied energy and lifecycle energy, Global warming and construction industry, Green concepts in buildings, Green building ratings IGBC and LEED manuals–mandatory requirements, Rainwater harvesting & Solar Passive Architecture, Environmental friendly and cost effective building technologies, Requirements for buildings of different climatic regions.

Self-study component:

Students will refer to the IGBC manuals and compare the aspects with the conventional buildings.

MODULE – 2	10Hrs.

Alternative Building Materials: Lime, Pozzolana cements, Raw materials, Manufacturing process, Properties and uses. Fiber Metal and synthetic, Properties and applications. Fiber reinforced plastics, Matrix materials, Fibers organic and synthetic, Properties and applications. Building materials from agro and industrial wastes, Types of agro wastes, Types of industrial and mine wastes, Properties and applications. Masonry blocks using industrial wastes. Construction and demolition wastes.

Self-study component:

Students will visit the Industries and Agricultural land and list out the possible alternative materials that can be incorporated in construction as Alternative Building materials.

MODULE -3	**10Hrs.**

Special Concretes: Definition & Introduction, General properties, Advantages, Disadvantages, Applications, High density concrete, Shrinkage compensating concrete, Mass concrete, Roller compacted concrete. Lightweight concrete, High strength concrete, Ultra-high strength concrete (reactive powder concrete), High workability concrete/Self compacting concrete, Fiber reinforced concrete, Polymer-concrete composites.

Self-study component:

Students will list out the special concrete and prepare the Mix design for the selected concrete.

MODULE -4	**10Hrs.**

I**ntroduction to Sustainability**: Carbon cycle and role of construction material such as concrete and steel, etc. CO2 contribution from cement and other construction materials. Control of energy use in building, ECBC code, codes in neighboring tropical countries, features of LEED and TERI Griha ratings,Sustainable Architecture and Design, Performance ratings of green buildings. Global temperature, Greenhouse effects, global warming. Acid rain - Causes, effects and control methods. Regional impacts of temperature change

Self-study component:

Students will compare features of LEED and TERI Griha ratings for sustainable architecture.Investigate global temperature trends, greenhouse effects and assess regional impacts of temperature change on ecosystems and human health.

Text Books:

1. Alternative Building Materials and Technologies ,K. S. Jagadish, B. V. Venkatarama Reddy and KS Nanjunda Rao,New Age International Publishers
2. Sustainable Construction: Green Building Design and delivery C. J. Kibert 3 rd Ed., John Wiley, Hoboken, New Jersey 2008

Reference Books:

1. Concrete Technology :Gambhir M. L. McGraw Hill Education 2006
2. Concrete Technology: Shetty M.S. S. Chand and Company Ltd. Delhi 2003
3. Building Materialsin: Developing Countries RJS Spence andDJ Cook Wiley pub.
4. IGBC manual-Indian Green building council (igbc.in)

MOOC Course:

1)https://onlinecourses.swayam2.ac.in/nou24_ge85/prevew

2) https://onlinecourses.nptel.ac.in/noc24_ar20/preview

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**													
CO2							**3**							
CO3	**3**						**2**	**3**	**3**			**3**		
CO4	**3**						**3**	**3**	**3**			**3**		

Course Title	MAJOR PROJECT PHASE - I		
Course Code	**22PROJ1**	**(L-T-P)C**	**(0-0-4)2**
Exam	**3 Hrs.**	**Hours/Week**	**4**
CIE+SEE	**50+50 Marks**	**Total Hours**	**50**

Course Objective: To involve in team work to demonstrate the acquired skill & knowledge gained 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)	**30 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 [POs]**													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1		**3**		**3**										
CO2		**3**		**3**	**3**								**3**	
CO3				**3**	**3**	**3**	**3**	**3**	**3**					**3**
CO4									**3**	**3**		**3**		**3**

Rubrics for Major Project Evaluation

		Proficient 9-10 - excellent	Acceptable 6-8- good	Needs Improvement 4-6- fair	Unacceptable 1-3- poor
1	**Organization**	Student shows enthusiasm and presents information in logical, interesting sequence which engages the audience.	Student presents information in logical sequence which audience can follow.	Audience has difficulty following presentation because student jumps around.	Delivery not smooth and audience attention lost because there is no sequence of information.
2	**Content**	Accurate and in depth information, sufficient amount of information, proper citing of resources.	Accurate information, sufficient information, some resources not cited.	Some information is inaccurate, sufficient information, some resources are not cited.	Information is inaccurate, most sources are not cited.
3	**Subject Knowledge**	Student demonstrates full knowledge (more than required) and answers all questions with explanations and elaboration.	Student is at ease with information and gives expected answers to all questions, but fails to elaborate.	Student is uncomfortable with information and is able to answer only rudimentary questions.	Student does not have grasp of information; student cannot answer questions about subject.
4	**Style/Mechanics (PowerPoint)**	The electronic presentation displays elements of creativity and style, and is not simply a list of information. The electronic presentation is presented in a clear and concise manner.	The electronic presentation is clear and logical and contains pertinent information and images. Good clear oral presentation.	Lacks style and reads more like a list of information, than as a support for an oral presentation. Lacks neatness and clarity.	The presentation lacks a clear focus and there are many errors. Electronic presentation is not creative.
5	**Communication & Time Management**	Student uses a clear voice and correct, precise pronunciation of terms so that all audience members can hear presentation. The presentation was of the proper duration.	Student's voice is clear. Student pronounces most words correctly. Most audience members can hear presentation. The presentation was of the proper duration.	Student's voice is low. Student incorrectly pronounces terms. Audience members have difficulty hearing presentation and/or the presentation was somewhat short or somewhat long.	Student mumbles, incorrectly pronounces terms, and speaks too quietly for students in the back of class to hear and/or the presentation was too brief or too long.
6	**Overall Rating**	**Excellent**	**Good**	**Fair**	**Needs improvement**

Course Title	SOFTWARE APPLICATION LABORATORY		
Course Code	22CVL606	(L-T-P) C	(0-0-2) 1
Exam	3 Hrs.	Hours/Week	2
CIE+SEE	50+50 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	-

Course Contents: **28Hrs.**

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.

Reference Books:

1. Suresh.G.S and Sheshaprakash, "CAD Laboratory (Civil Engg)" - C-Graphics & Excel, Jawaharlal Nehru National College of Engineering, Shimoga, 2004
2. Jayaram.M.A, Rajendraprasad.D.S, "CAD Laboratory" – Sapna Publications, 2003.
3. Sham Tickoo, "AUTOCAD 2004" A beginner's Guide, Wiley Dreamtech India Pvt.Ltd, 2004.
4. Ramesh Bangia "Learning Excel 2002" Khanna Book Publishing Co (P) ltd, 2002

MOOC/NPTEL Courses:

1. **Matlab Programming for Numerical Computation - Course (nptel.ac.in)**
2. **Matlab Programming for Numerical Computation - YouTube**
3. **MATLAB Programming: Lesson 1 - Introduction to MATLAB and Numerical Analysis (youtube.com)**

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	**3**	**2**			**3**									**2**
CO2	**3**	**2**	**2**		**3**									**2**
CO3	**3**	**2**	**2**		**3**									

Course Title	ADVANCED SURVEY TRAINING		
Course Code	22CV607	(L-T-P) C	(0-0-2) 1
Exam	2 Hrs.	Hours/Week	02
CIE+SEE	50+50 Marks	Total Hours	28

Course Objective:

To understand the basics and elements of different types of curves on roads and their Preliminary survey

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	
2.	Design various components in Old tank, Water supply, Highway, Layout projects to prepare drawings with detailed report.	PO4, PO5, PO9, PO11	PSO2

MODULE – 1	4 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	4 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	4 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	4 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.

Reference Materials:

1. Basak. N. N., "Surveying", Tata McGraw Hill Publishing Co., ltd, 2004
2. Punmia, B. C, "Irrigation and Water Power Engineering", Laxmi Publications, New Delhi, 1992.
3. Khanna, S. K. & Justo CES, "Highway Engineering", Nemchand Brothers, Roorkee, 2003
4. Garg, S. K., "Water Supply Engineering", Khanna Publishers, New Delhi, 2007.

MOOC Course:

1. Digital Land Surveying And Mapping (DLS&M) - Course (nptel.ac.in)

Course Articulation Matrix

Course Outcomes	Program Outcomes [POs]													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1				2	3				2		1			
CO2				2	3				2		1			

Course Title	ANALYTICAL ABILITY AND SOFT SKILLS	
Course Code	22ASK	L-T-P-C (0-1-0)1
Exam Hrs.	1	Hours / Week 2
SEE	50 Marks	Total Hours 30

Course Objective: To Enhance problem solving skills and communication skills

Course Outcomes (COs) : Upon completion of the course, students shall be able to:

COs	Course Outcomes	Mapping to POs
CO1	Apply methods to solve numerical and reasoning problems	PO2, PO3
CO2	Lead a team in corporate offices	PO8, PO9
CO3	Communicate effectively in professional ambience	PO10

MODULE – 1

Hard Skills: Speed/Distance, Probability, Permutations/Combinations, Profit/Loss, Simple Interest/Compound Interest, Number theories, Number/Letter series, Coding/Decoding, Blood relations, Directions, Clock, Calendar. Logical reasoning problems **(40Hrs.)**

MODULE – 2

Soft Skills: Basic grammar, Spotting errors, Sentence formation, Email writing, Public speaking, Client communication, Leadership, Managerial skills, Stress management, Presentation Skills **(15Hrs)**

MODULE – 3

Technical Skills: Review of C programming, Simple coding, Syntax rules, MCQs on C language.

(15Hrs.)

MODULE – 4

Activities: GD, JAM, Mock Interview, Pick and speak, Presentation **(14Hrs.)**

Course articulation matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	Po10
CO1		2	3							
CO2								1	3	
CO3										3