Academic Program: UG

Academic Year 2024-25 Syllabus

VII & VIII Semester B.E.

(Civil Engineering)

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution approved by AICTE & Affiliated to VTU, Belagavi)

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for VII & VIII semester of UG program in Civil Engineering is recommended by Board of Studies of Civil Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2024-25 till further revision.

Principal

Chairman BoS & HoD

SDM College of Engineering & Technology, Dharwad

Department of Civil Engineering

Vision and Mission of the Institute

SDMCET –Vision

To develop competent professionals with human values.

SDMCET – Mission

- To have contextually relevant Curricula.
- To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
- To enhance Research Culture.
- To involve the Industrial Expertise for connecting Classroom contents to real-life situations.
- To inculcate Ethics and soft skills leading to overall personality development.

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DEPARTMENT OF CIVIL ENGINEERING

VISION AND MISSION

Vision:

To be the center of excellence providing the state of art civil engineering education developing competent engineers responsible for serving modern society.

Mission:

The stated vision can be achieved through:

- The development of robust curricula to meet industrial expectations.
- Interactive teaching-learning process with modern educational tools and soft skills.
- Establishing synergy between teaching and research
- Industry-Institute interaction.

Program Educational Objectives (PEOs)

I. **Technical adeptness**: The Civil Engineering Graduates will be technically adept to specific fields and other disciplines. and Management towards Planning, Design, and Costing. Their technical skills and knowledge will enable them to perform their work with a commitment and quality, timeliness with continuous improvement.

II. **Interpersonal Skills**: Civil Engineering Graduates will exhibit effective interpersonal skills in teams and at workplace.

III. **Awareness of Social impact:** Graduates will be made aware of causes of impacts due to the development and to identify remedial measures if necessary.

IV. **Professionalism:** Understanding of professionalism, ethics, quality performance, sustainability and allow them to be professional leaders and contributors to society through their problem-solving capabilities and executing the work.

V. **Continuous Learning:** Civil Engineering Graduates will exhibit interest in lifelong learning including studies leading to professional licensure or higher studies in engineering that provides for continued development of their technical ability and management skills

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2. **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.

PO3. **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.

PO4. **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.

PO5. **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.

PO6. **The Engineer and society**: Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10. **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.

PO11.**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PO12.**Lifelong learning:** Recognize the need for and have the preparation and ability to engage in independent and lifelong learning in the broadest context to technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO13.**Project inception and design:** Conceptualize projects related to different fields of Civil Engineering, collect relevant data by direct and indirect methods, analyze the project requirement and design the project.

PSO14.**Draft specification**: Select material, prepare estimates/costing, schedule work plans.

PSO15.**Experimentation**: Apply knowledge of different fields of Civil Engineering, conduct experiments, analyze, interpret data, and design the system components.

VII Semester B. E.

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
21UCVC700	PC	Wastewater Engineering	3 - 0 - 0	3	50	100	3	-	-
21UCVE7XX	PE	Program Elective course - 3	3 - 0 - 0	3	50	100	3	-	-
21UCVE7XX	PE	Program Elective course - 4	3 - 0 - 0	3	50	100	3	-	-
21UCVE7XX	PE	Program Elective course - 5	3 - 0 - 0	3	50	100	3	-	-
21UCVO7XX	OE	Open Elective course - 3	3 - 0 - 0	3	50	100	3	--	--
21UHUC700	HU	Research Methodology	2 - 0 - 0	2	50	50	2	--	--
21UCVL701	PC	Environmental Engineering Laboratory	0 - 0 - 2	1	50	--	--	50	3
21UCVL702	PC	Major Project Phase - 1	0 - 0 – 4	2	50	--	--	50	3
		Total	**17 - 0 – 6**	**20**	**400**	**550**		**100**	

PC- Program Core, PE-Program Elective, OE- Open Elective and HU- Humanities,

List of Elective Courses

Course Code	Course Title
21UCVE714	Advanced design of RC Structures
21UCVE715	Design of RC Bridge
21UCVE716	Structural Dynamics
21UCVE718	Ground improvement techniques.
21UCVE725	Earthquake resistant structures
21UCVE726	Construction Management and Equipment
21UCVE727	Design of Prestressed Concrete Structures
21UCVE728	Urban Transport Planning
21UCVE729	Solid waste Management
21UCVE730	Advanced Design of Steel Structures
21UCVE731	Hydraulic & Hydraulic Machines
21UCVE732	Water Resource Engineering
21UCVE733	Traffic Engineering & Management

List of Open Elective Course

Course Code	Course Title
21UCVO751	Remote Sensing & GIS

CIE: Continuous Internal Evaluation **Semester End Examination**: Semester End Examination
L: Lecture **T**: Tutorials **P**: Practical
*Semester End Examination for theory courses is conducted for 100 marks and reduced to 50 marks.

VIII Semester B. E.

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
21UCVL800	PC	Technical Seminar/ Independent study	0 - 0 - 2	1	50	--	--	--	--
21UCVL801	PC	Major Project Phase - 2	0 - 0 -18	9	50	--	--	50	3
21UCVL802	PC	Internship - 2	4 - 6 weeks	3	50	--	--	50	3
	Total		**0 – 0 - 20**	**13**	**150**			**100**	

PC- Program Core, PE-Program Elective and OE- Open Elective

Total credits for 4th year: 33

21UCVC700	Wastewater Engineering	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): Wastewater Engineering is taught as a core course in Civil Engineering program. In this course, topics on wastewater, its generation, disposal, quantification and characterization of sewage to design sewers and treat sewage to the required standards, are dealt with. The evaluation will be carried out through IAs and Semester End Examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Describe the necessity for sanitation, types of sewerage systems, compute the quantity of sewage.		1,6	
CO-2	Describe sewer appurtenances, design the sewers.	3	2	6
CO-3	Analyze sewage for various parameters, design the pumping system.		4	
CO-4	Describe self-purification, design sewage disposal systems.	7	9	12
CO-5	Analyze various treatment methods for sewage, design various treatment units.	13	4	12

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2	2	3	2		1.5	3		2			1			3

Contents:

Unit-I

Introduction - Necessity for sanitation, methods of sewage disposal, types of sewerage systems and their suitability.

Quantity of Sewage: Dry weather flow, factors effecting dry weather flow, flow variations and their effects on design of sewerage system, computation of design

flow, estimation of storm flow, time of concentration, rational method and empirical formulae of design of storm water drain. **8 Hrs**

Unit-II

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**.**

Materials of Sewers and Sewer Appurtenances: Sewer materials, shapes of sewers, laying of sewers, jointing and testing of sewers, ventilation and cleaning of sewers. Catch basins, manholes, drainage traps, basic principles of house drainage, typical layout plan showing house drainage connections. 7 **Hrs**

Unit-III

Analysis of Sewage: Physical, chemical and biological characteristics, concepts of aerobic and anaerobic activity, CNS cycles, with emphasis on BOD and COD.

Sewage Pumping: Need, types of pumps, design of pumps. 7 **Hrs**

Unit-IV

Disposal of Effluents: By dilution, self-purification, phenomenon, design sewage disposal systems - oxygen sag curve, zones of purification, sewage farming, sewage sickness, disposal standards on land and water. **9 Hrs**

Unit-V

Treatment of Sewage: Flow diagram of municipal sewage treatment plant**,** primary treatment, screening, grit chambers, primary sedimentation tanks, designs, secondary treatment: trickling filter, theory and operation, types and designs, activated sludge process, principle and flow diagram, methods of aeration, designs of ASP, methods of sludge disposal, sludge drying beds.

Miscellaneous Treatment Methods: Septic tanks, oxidation ponds – design. Introduction to RBC, UASB, anaerobic filters. **8 Hrs**

Reference Books:

1) CPHEEO-Manual on Wastewater Treatment, Ministry of Urban Development, New Delhi, 6th Edition 2007.
2) E.W. Steel and Terence J. McGee, “Water Supply and Sewage”, Tata McGraw Hill Publications, New Delhi.
3) Ethlers Victor M, Schroeder Edward D and Steel E.W, “Water and Wastewater treatment”, McGraw Hill, New Delhi,1977.
4) Garg S.K, “Sewage Disposal and Air Pollution Engineering”, Khanna Publishers, New Delhi, 39th Edition 2019.

21UHUC700	Research Methodology	(2-0-0) 2

Contact Hours: 26

Course Learning Objectives (CLOs):

The students are expected to learn about the needs and types of research, problem formulation, literature review, measurement, scaling, data collection, testing of hypothesis, result interpretation and report writing.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Formulate the research problem, carryout literature survey and decide the methodology.	-	1	-
CO-2	Use measurement and scaling and carryout data collection.	-	1	-
CO-3	Test the hypothesis, interpret &analyze the results, and write the report.	2	3	-
CO-4	Explain the need for interpretation and report writing	-	2	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**
Mapping Level	2	2.2	2	-	-	-

Contents:

Unit-I

Research Methodology: Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology.

Defining the Research Problem: Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration. **06 Hrs**

Unit-II

Reviewing literature: Importance of literature review in research, how to review the literature, searching the existing literature, reviewing the selected literature, and writing about the literature reviewed.

Research Design: Meaning of research design, need for research design, features of a good design, important concepts relating to research design. **05 Hrs**

Unit-III

Measurement and Scaling: Measurement in research, measurement scales, sources of error in measurement, scaling, meaning of scaling and important scaling techniques.

Data Collection: Collection of primary data, observation method, interview method, collection of data through questionnaires. **05 Hrs**

Unit-IV

Testing of Hypotheses: What is a Hypothesis? Basic concepts concerning testing of hypotheses, procedure for hypothesis testing, flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses. **05 Hrs**

Unit-V

Interpretation and Report Writing: Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation, and mechanics of writing a research report, precautions for writing research reports, plagiarism, and its significance. **05 Hrs**

Reference Books:

1) C.R. Kothari, Gaurav Garg, Research Methodology: Methods and Techniques, New Age International, 4 th Edition, 2018.
2) RanjitKumar, Research Methodology a step-by-step guide for beginners, SAGE Publications, 3rdEdition, 2011.
3) Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications, 2009.

21UCVL701	Environmental Engineering Laboratory	(0-0-2)1

Contact Hours: 26

Course Learning Objective (CLOs): The course deals with testing and characterization of water and wastewater parameters learnt in the core environmental subjects. The usage of trimetric and instrumental methods is dealt with. The delivery of topics will be made through instruction classes, demonstration, and Laboratory work.

Course Outcomes (COs):

ID	Description of the Course Outcome:	Mapping to POs (1-12)/ PSOs (13-15)		
		Substantial	Moderate	Slight

	At the end of the course the student will be able to:	Level (3)	Level (2)	Level (1)
CO-1	Determine the potability of water and interpret the results as per IS standards.	15	7	9
CO-2	Determine the level of pollution in water & wastewater and interpret the results for different uses.	15	7	9

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level							2		1						3

Course contents:

1. Determination of solids in sewage: Total, suspended, dissolved, volatile, fixed, settleable.
2. Determination of turbidity: By Jackson, Nephelo, Aplab turbidity meters.
3. Determination of electrical conductivity, Chlorides and Sulphates.
4. Determination of Alkalinity, Acidity and pH.
5. Determination of calcium, magnesium and total hardness.
6. Determination of Dissolved Oxygen and BOD.
7. Determination of COD.
8. Determination of percentage of available chlorine in bleaching powder, Residual Chlorine and Chlorine Demand.
9. Jar Test for Optimum Dosage of Alum.
10. Determination of Iron.
11. Determination of Fluorides and Nitrates.
12. Total Count Test & Determination of MPN.

Reference Books/Manuals/ IS Codes:

1) IS: 10500- 2012, “Drinking water — specification”.
2) “Standard Methods for Examination of Water and Wastewater”, APHA, AWWA, WPCF.
3) “Manual of Water & Wastewater Analysis”, NEERI Publication.
4) Sawyer and Mc Carty, “Chemistry for Environment Engineering and Science”, McGraw Hill. 5th Edition, 2017.

21UCVL702	Major Project Phase – 1	(0-0-4) 2

Contact Hours: 52

Course Learning Objective (CLOs): Major Project phase-I is carried out under the guidance of a faculty. In this course, the students will finalize the project title,

collect the data required by indirect and direct methods and carry out literature review and formulate the methodology.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify and define the project.	13	1	9,12
CO-2	Collect data by direct and indirect methods.	2	13	9,12
CO-3	Carry out literature survey.	1		9,12
CO-4	Formulate the methodology.	2	2	9,12
CO-5	Conduct required experiment. Interpret the test data/ results, draw conclusions.		15	9,12

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	2.5	2.66							1			1	2.5		2

21UCVE714 Advanced Design of RC Structures (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): Advanced design of RC structure is taught as one of the elective courses in Civil Engineering program. In this course, design and drawing of simple portal frame, circular and rectangular water tank, cantilever and counter fort retaining wall and raft and strap beam footings are dealt along with detailed drawings of structural components. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs and Semester End Examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Design Portal frame, water tank, retaining wall and foundations.		2,13	1
CO-2	Prepare the structural drawings of Portal frame, water tank, retaining		2,13	1

	wall and foundations.			
CO-3	Prepare the structural drawings for staircase, continuous beam, column footing, slab systems, prepare layout drawings for the components of the structure.		2,13	1

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1	2											2		

Contents:

Unit-I

Portal frames: Design and Drawing of the single bay, single storey portal frame. **7 Hrs**

Unit-II

Water tank: Design and Drawing of the water tanks (circular and rectangular resting on the ground) as per IS code method. **8 Hrs**

Unit-III

Retaining wall: Design and Drawing of the cantilever and counterfort retaining walls. **8 Hrs**

Unit-IV

Foundation: Design and Drawing of the combined, raft and strap beam footing. **8Hrs**

Unit-V

Detailing: Prepare detailed drawings of staircases, beam and slab systems, column footing and layout drawing for a structure. **8 Hrs**

Question paper pattern:

Part A – 2 Questions of 60 marks each are to be set from Unit I to unit IV out of which anyone is to be answered.

Part B – 3 Questions of 20 marks each are to be set from Unit V out of which any two are to be answered.

Reference Books:

1) IS 456-2000 “Plain and Reinforced Concrete Code of Practice”.
2) SP16 - 1980 “Design Aids for Reinforced Concrete”
3) Krishnamurthy, “Structural Design and Drawing (Concrete Structures) - Volume 2”, CBS, Publications, New Delhi,1st Edition, 2018.
4) Krishnaraju N., “Structural Design and Drawing”, University press, Hyderabad, 3rd edition, 2009.
5) SP-34: 1987, “Handbook on concrete reinforcement and detailing”.
6) IS 3370: 2009, “Concrete Structures for Storage of Liquids-Code of Practice”.

7) IS: 875 :1987 Part I to V, “Code of Practice for Design Loads (Other than earthquake) For Buildings and Structures”.

21UCVE715	Design of Reinforced Concrete Bridges	(3-0-0) 3

Contact Hours:39

Course Learning Objectives (CLOs): Design of Reinforced Concrete bridges is taught as one of the elective courses in Civil Engineering program. In this course, analysis, and design of reinforced concrete bridges viz, slab culvert, T beam bridge, and box culvert are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs & Semester End Examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Analyze and design slab culvert.	1,3	13	
CO-2	Analyze and design T beam slab panel.	1,3	13	
CO-3	Analyze and design cross girder	1,3	13	
CO-4	Analyze and design longitudinal girder.	1,3	13	
CO-5	Analyze and design box culvert.	1,3	13	

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	3		3										2		

Contents:

Unit-I

Design of RCC Slab Culvert: Design of slab culvert for IRC Class AA tracked and Class A Wheel load condition, Dead load Bending moment and Shear force, Length and Breadth of dispersion, Impact factor, Live load Bending moment and Shear force, Design of reinforcement. **10 Hrs**

Unit-II

Design of T Beam Bridge Slab Panel: Design of interior Slab panel Using IRC Class AA Tracked Loading and IRC Class A wheel loading, Pigeaud’s curve, Dead load Bending moment and Shear force, Live load bending moment and Shear force, Design of reinforcement. **6 Hrs**

Unit III

Design of Cross Girder: Design of cross girder for dead load & live load using IRC Class AA Tracked load, Dead load Bending moment and Shear force, Live load bending moment and Shear force, Design of reinforcement. **6 Hrs**

Unit-IV

Design of Longitudinal Girder: Design of longitudinal girder using IRC Class AA Tracked, Class A wheel Loading, Reaction factor, Dead load Bending moment and Shear force, Live load bending moment and Shear force, Design of reinforcement. **8 Hrs**

Unit-V

Design of Box Culvert: Design of Box culvert, load combination for DL, LL and Water pressure, Moment Distribution method, Design of reinforcement. **9 Hrs**

Reference Books:

1) Victor D.J and Johnson, "Essentials of Bridge Engineering", Oxford and IBH, 6th edition, 2019.
2) Krishnaraju N., "Design of bridges", Oxford & IBH Publishers, 4th edition 2019.
3) Bindra S.P., "Principles and Practice of Bridge Engineering", Dhanpat Rai Publications, 2012.
4) T R Jagadish and M A Jayaram, "Design of Bridge Structures", PHI, Eastern Economy Edition, 3rd edition, 2021.
5) IRC: 6 – 2017, "Standard Specifications and Code of Practice for Road Bridges"
6) IRC: 21 – 2000, "Standard Specification and Code of Practice for Road Bridge".

21UCVE716	Structural Dynamics	(3-0-0) 3

Contact Hours:39

Course Learning Objectives (CLOs): Structural Dynamics is taught as one of the elective courses for civil engineering programs. In this course, mathematical model for single degree, multi degree of freedom systems for un-damped, damped forced and free vibrations are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IA tests and Semester End Examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain D-Alembert's principle, SDOFS for free vibration of damped	1,2	3	

	un-damped systems.			
CO-2	Explain Harmonic loading case and vibration isolation system for SDOFS.	1,2	3	
CO-3	Explain the effect of impulse load using Duhamel's Integral.	1,2	3	
CO-4	Apply the knowledge of Fourier series in structural dynamics.	1,2	3	
CO-5	Analyze the Multi storey shear building under free and forced vibration for damped and un-damped conditions.	1,2	3	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	3	3	2												

Contents:

Unit-I

Single Degree of Freedom System: Degrees of freedom, un-damped system, springs in parallel and series. Newton's laws of motion, free body diagrams. D'Alembert's principle, solution of the differential equation of motion, frequency and period, amplitude of motion. Damped Single degree of freedom system – viscous damping, equation of motion, damped system - critically, over, under and logarithmic decrement. **8 Hrs**

Unit-II

Harmonic Loading: Response of single degree of freedom system to harmonic loading – un-damped harmonic excitation, damped harmonic excitation, evaluation of damping at resonance, bandwidth method (Half power) to evaluate damping, response to support motion, force transmitted to the foundation, Dynamic Magnification Factor, generalized single degree of freedom system (rigid body and distributed elasticity). **8 Hrs**

Unit-III

Impulse load using Duhamel's integral: Response to general dynamic loading, Impulsive loading and Duhamel's integral – Un damped system, Duhamel's integral –Damped system **8 Hrs**

Unit-IV

Application of Fourier series: Fourier analysis and response in frequency domain – Fourier analysis, Fourier co-efficient for piece-wise linear functions, exponential form of Fourier series, discrete Fourier analysis, fast Fourier transforms. **7 Hrs**

Unit-V

Multi Degree of Freedom System: Introduction, Generalized Co-ordinates and Rayleigh's method, Multistory Shear Building, free vibration – natural frequencies and normal modes, zero modes of vibration, forced vibration – modal superposition method, response of a shear building to base motion. Damped motion of shear building – equations of motions, Introduction to dampers and their types. **8 Hrs**

Reference Books:

1. Mario Paz, "Structural Dynamics, Theory and Computation", CBS Publisher, 2nd Edition, 2004.
2. Mukhopadhyaya, "Vibration, Dynamics and Structural Problems," Oxford IBH Publishers,1st Edition, 2017
3. Clough, Ray W and Penzien J, "Dynamics of Structures", McGraw-Hill, 2nd Edition, 1993.

Roy R. Craig, Andrew J. Kurdila, "Fundamentals of Structural Dynamics", John Wiley & Sons, 2nd Edition, 2006.

21UCVE718 Ground Improvement Techniques (3-0-0)3

Contact Hours: 39

Course Learning Objective (CLOs): Ground Improvement Techniques is taught as one of elective courses for Civil Engineering Program. The course refers to the improvements or modifications to the engineering properties of soil or rock that are carried out at the site. Mechanical modification, hydraulic modification, chemical modification, grouting, geosynthetic material properties and applications and other miscellaneous methods are dealt along with typical field problems and their remedial measures. The delivery of the topics is achieved through lecture classes, problem solving and demonstrations. The evaluation will be carried out through IAs & Semester End Examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain the objectives of ground improvement and various methods, liquefaction, compaction mechanics and methods.	1	1,2	12
CO-2	Explain dewatering and methods, pre-compression, vertical drains.	1	2	12

CO-3	Explain methods of chemical stabilization using cement, lime, fly-ash and other chemicals.		1	7,12
CO-4	Explain vibration and grouting techniques, procedures and applications.	1		12
CO-5	Explain the miscellaneous methods of ground improvement techniques.		1	12

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2.5	2					1					1			

Contents:

Unit-I

Ground improvement: Definition, Objectives of soil improvement, classification of ground improvement techniques, factors to be considered in the selection of suitable soil improvement technique.

Liquefaction: Potential – Hazardous, poor, and favorable ground conditions. Compaction mechanics, field procedures, surface compaction, dynamic compaction, selection of field compaction methods, compaction control. **8Hrs**

Unit-II

Drainage Methods: Introduction, Seepage, filter requirements, ground water and seepage control, methods of dewatering, design of dewatering system including pipeline, effects of dewatering. Drains and types of drains.

Pre-compression and Vertical Drains: Importance, vertical drains, sand drains, drainage of slopes, electro kinetic dewatering, preloading. **8Hrs**

Unit-III

Chemical Stabilization: Objectives, special effects, and methods, techniques - sandwich technique, admixtures, cement stabilization. Hydration - effect of cement stabilization on permeability, swelling and shrinkage, criteria for cement stabilization, lime stabilization-suitability, process, special effects, criteria for lime stabilization, other chemicals - chlorides, hydroxides, lignin, hydrofluoric acid, fly ash in cement stabilization, properties of chemical components, reactions and effects, bitumen, tar or asphalt in stabilization. **8Hrs**

Unit - IV

Vibration methods: Introduction, Vibro compaction – blasting, vibratory probe, Vibro displacement – displacement piles, vibro flotation, sand compaction piles, stone columns, heavy tamping.

Grouting methods: Introduction, effect of grouting. chemicals and materials used. Types, procedures, and applications of grouting. **8Hrs**

Unit-V

Miscellaneous methods: Soil reinforcement, thermal methods, ground improvement by confinement - crib walls, gabions & mattresses, anchors, rock bolts and soil nailing. **7Hrs**

Reference Books:

1) Ingles, C.G and Metcalf.J.B., "Soil Stabilization; Principles and Practice", Butterworths, London, 3rd edition, 2000.
2) Purushotham Raj P, "Soil Mechanics & Foundation Engineering", Pearson Education Ltd Publishers, 2nd edition, 2016.
3) Dr. K. R. Arora, "Soil Mechanics and Foundation Engineering", Laxmi publication, 7th edition, 2017.

21UCVE725 Earthquake Resistant structures (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): Earthquake Resistant Structures is taught as one of elective courses for Civil Engineering Program. In this course, topics on Seismic hazard assessment; Earthquake effects on structures, Concepts of earthquake resistant design of masonry and earthen buildings are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs & SEE.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOS (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss Engineering seismology, seismic instruments, Structural behavior under seismic load, dampers and base isolation techniques.		6	
CO-2	Discuss characteristics of earthquake force by response spectrum, tripartite plot, calculate seismic forces using standard procedures.	2,3		
CO-3	Discuss structural configuration and concepts for earthquake resistant masonry buildings as per codal provisions.	2,3		

CO-4	Design reinforced concrete buildings.	2,3		
CO-5	Carry out seismic evaluation and select appropriate retrofitting method.		6	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level		3	3			2									

Contents:

Unit-I

Seismic Hazard assessment: Introduction to engineering seismology, Geological and tectonic features of India, Origin and propagation of seismic waves, characteristics of earthquake and its quantification – Magnitude and Intensity scales, seismic instruments. Earthquake Hazards in India, Earthquake Risk Evaluation and Mitigation. Structural behavior under gravity and seismic loads, Lateral load resisting structural systems, Requirements of efficient earthquake resistant structural system, damping devises, base isolation systems. **10 Hrs**

Unit-II

Earthquake effects on structure: The Response history and strong motion characteristics. Response Spectrum – elastic and inelastic response spectra, tripartite (D-V-A) response spectrum, use of response spectrum in earthquake resistant design. Computation of seismic forces in multi-storied buildings – using procedures (Equivalent lateral force only) as per IS1893. **8 Hrs**

Unit-III

Concepts of earthquake resistant design: Structural Configuration for earthquake resistant design, Concept of plan irregularities and vertical irregularities, Soft storey, Torsion in buildings. Design provisions for these in IS-1893. Effect of infill masonry walls on frames, modeling concepts of infill masonry walls. Behavior of masonry buildings during earthquakes, failure patterns, strength of masonry in shear and flexure, Slenderness concept of masonry walls, concepts for earthquake resistant masonry buildings – codal provision. **7 Hrs**

Unit-IV

Design of earthquake resistant RC structures: Design of Reinforced concrete buildings for earthquake resistance-Load combinations, Ductility and energy absorption in buildings. Confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing provisions as per IS code. Structural behavior, design and ductile detailing of shear walls. **8Hrs**

Unit-V

Seismic response control: Seismic demand, seismic capacity, Overview of linear and nonlinear procedures of seismic analysis. Performance Based Seismic Engineering methodology, Seismic evaluation and retrofitting of structures. **6 Hrs**

Reference Books:

1) Pankaj Agarwal and Manish Shrikande" Earthquake Resistant Design of structures", published by PHI Learnings", year 2006 ,1st edition.
2) S.K.Duggal," Earthquake Resistant Design of structures", published by Oxford University Press, year 2007,2nd edition.
3) IS 1893(part1):2016" criteria for Earthquake Resistant Design of structures" 6th revision BIS 2016
4) IS 13920:2016 "Ductile detailing of reinforced concrete structures subjected to seismic forces"-code of practice 1st revision, BIS 2016.

21UCVE726 Construction Management and Equipment (3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs): Construction, Equipment and Management is taught as one of the elective courses in Civil Engineering program. In this course, topics on construction industry and management, construction planning, construction equipment and construction safety are dealt. The delivery of topics will be made through lecture classes and site visits. The evaluation will be carried out through IAs and Semester End Exam.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOS (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain importance of construction industry, various aspects of material, labor, financial management.	1,8,11	10	12
CO-2	Prepare project schedule using PERT and CPM.	2	4	5
CO-3	Explain project costs resource management.	2	6	
CO-4	Explain construction equipment and their suitability for different works.		6	10,11
CO-5	Explain causes of accidents, safety measures and methods of	6	8	12

	improvements of safety at site.			

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	3	3	2	1	2.33	2.5	1.5	2	1						

Contents:

Unit - I

Construction industry: Introduction to construction industry, labor, material, time and financial management. **8 Hrs**

Unit - II

Construction planning: Introduction, Project planning methods, Bar and Milestone chart.

Network Analysis: Introduction to PERT and CPM. Numerical problems. **8 Hrs**

Unit - III

Project Cost: Cost model, direct, indirect and optimum costs, optimum duration and numerical problems.

Resource Management: Introduction, types of resources, resource allocation, updating and line of balance technique. **8 Hrs**

Unit - IV

Introduction to Equipment: Types of equipment, factors for selection of equipment, efficiency, output and maintenance of equipment.

Construction Equipment: Earth moving equipment, concrete mixer and plants, highway construction equipment, hoisting equipment, conveyors and rollers, trenching machines. **8 Hrs**

Unit - V

Construction safety: Introduction, causes of accidents, common hazards, occupational health & hygiene, risks to health at work, general safety precautions.

Improvement in Safety: Approaches to improve construction safety, organizational approval, physical approach, behavioral and economic incentive approach, safety measures for fire and noise. **7 Hrs**

Reference Books:

1) Seetharaman S., “Construction Engineering and Management”, Umesh publication, Delhi. 5th Edition, 2017.
2) Peurifoy R.L., Ledbetter W.B., Schexnayder C., “Construction Planning, Equipment and Methods”, Tata McGraw Hill, New Delhi. 6th Edition, 2001.
3) Sharma S.C., “Construction Equipment and Management”, Khanna Publishers, New Delhi. 1st Edition, 2019.
4) Deodhar S.V., “Construction Equipment and Job Planning”, Khanna Publishers, New Delhi.

5) SP 7:2005, “National Building Code of India”, Bureau of Indian Standards, New Delhi. 2nd Revision, 2005.
6) SP 70:2001, “Handbook on Construction safety Practices”, Bureau of Indian Standards, New Delhi. 1st Reprint, 2007.
7) S.S. Chitkara, “Construction project management: Planning, scheduling and controlling”, McGraw Higher Ed. 3rd Edition, 2014.

21UCVE727 Design of Prestressed Concrete Structures (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): Design of Prestressed Concrete Structures is taught as one of elective courses in Civil Engineering program. In this course, basic material properties, fundamental principles of prestressing, analysis and design of flexural members, loss of prestress, design of end-blocks and design of composite sections are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs and SEE.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain basic properties of prestressed concrete constituents and analyze different methods.	1	13	
CO-2	Evaluate short term and long-term losses and deflections in prestressing structures.	2		
CO-3	Analyze sections for shear and flexure.	3,8		
CO-4	Analyze stresses in anchorage zones, composite beams and design the end blocks as per relevant I.S. codes.	2,8		
CO-5	Design different types of prestressed concrete beams.	3,8		

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	3	3	3					3					2		

Contents:

Unit-I

Materials: High strength concrete and steel, Stress-Strain characteristics and properties

Basic principles of pre-stressing: Fundamentals, Pre-tensioning and post-tensioning systems, tensioning methods and end anchorages Load balancing concept, Stress concept, Strength concept, P Line.

Analysis of sections for flexure: Stresses in concrete due to pre-stress and loads, stresses in steel due to loads, Cable profiles. **9Hrs**

Unit-II

Losses of pre-stress: Various losses encountered in pre-tensioning and post tensioning methods, determination of jacking force.

Deflections: Prediction of short term and long-term deflections of un-cracked members **10 Hrs**

Unit-III

Limit state of collapse and serviceability: IS Code recommendations – Ultimate flexural and shear resistance of sections, shear reinforcement. Limit state of serviceability, control of deflections and cracking. Type of members and flexural tensile stress.

Flexural strength of PSC section: Estimate flexural strength of section using IS code method. **7 Hrs**

Unit-IV

Design of end blocks: Transmission of prestress in pretensioned members, transmission length, anchorage stress in post-tensioned members. Bearing stress and bearing tensile force-stresses in end blocks-Methods, IS Code, provision for the design of end block reinforcement, design of bearing plates.

Analysis of composite PSC beams: Propped and un-propped beams. **7 Hrs**

Unit-V

Design of beams: Design of pre-tensioned and post-tensioned symmetrical and asymmetrical sections. Permissible stress, design of pre-stressing force and eccentricity, limiting zone of pre-stressing force cable profile. **6 Hrs**

Reference Books:

1) Krishna Raju N., “Prestressed Concrete”, Tata McGraw. 6th Edition, 2018.
2) Ned H Burns and T.Y. Lin, “Prestressed Concrete Structures”, Wiley India. 3rd Edition, 2010.
3) Vanakudre S.B. & Ashish Yeligar, “Prestressed Concrete Materials, Analysis & Design”, Khanna Publishers, New Delhi. 1st Edition, 2020.
4) IS 1343: 2012 “Code of Practice for Prestressed Concrete”.

21UCVE728	Urban Transport Planning	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs): Urban Transport Planning is taught as one of the elective subjects for Civil Engineering program. In this course, system approach to urban transport planning, transport survey, trip generation, trip distribution, modal split, trip assignment is dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs and Session End Examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOS (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss System Approach for transport planning process.			1,2
CO-2	Summarize various surveys for an efficient transit system and develop multiple regression equation to predict trip generation rate.	1,2,12		
CO-3	Evaluate trip distribution between internal zonal movements.			1,2
CO-4	Analyze the trip rate by modal split in the study area.		1,2,12	
CO-5	Examine the trip interchanges in different parts of road network.			1,2,12

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	1.6	1.6										2			

Contents:

Unit-I

Introduction: Scope of Urban Transport Planning, Inter dependence of land use and traffic, System approach to Urban Transport Planning.

Stages in Urban Transport Planning: Trip Generation-Trip Production-Trip distribution-modal - split-trip assignment, Fratar and Furnace methods **10 Hrs**

Unit-II

Urban Transport Survey: Definition of study area-zoning-types of surveys-inventory of Transport facilities - expansion of data from sample.
Trip Generation: Trip purpose-factors governing trip generation and attraction-category analysis - problems **7 Hrs**

Unit-III

Trip Distribution: Methods-Growth factor methods-synthetic methods-Fratar Method and Furness method- problems. **7 Hrs**

Unit-IV

Trip Assignment: Assignment techniques-traffic forecasting, problems
Modal Split: factors affecting- characteristics of split- modal split in Urban Transport Planning and Problems. **8 Hrs**

Unit-V

Urban Transport Planning for Small and Medium Cities: Introduction-difficulties in Transport planning-recent studies.
Urban transport systems – Introduction to urban transport systems. **7 Hrs**

Reference Books:

1) Kadiyali L.R., "Traffic Engineering and Transport Planning", Khanna Publishers, New Delhi, Ninth Edition, 2017.
2) Papacostas C.S., Prevedouros P.D., "Transportation Engineering and Planning", Prentice-Hall of India, Pvt. Ltd, New Delhi, Third Edition, 2009.
3) Wilson A G.,"Entropy in Urban and Regional Modeling", Pion Ltd., London. First Edition, 2012.

21UCVE729	Solid Waste management	(3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs): Solid Waste Management is taught as one of elective courses for Civil Engineering Program. In this course, topics on sources, impacts, treatment, disposal of solid waste, design aspects of landfills and monitoring leachates and gases are dealt with. The delivery of topics will be made through lecture classes and field visits. The evaluation will be carried out through IAs and Semester End Examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Estimate the quantities of Solid wastes from different sources and		1, 2	-

	recognize the possible health hazards of their disposal.			
CO-2	Analyze physical, chemical biological and energy characteristics of solid wastes and differentiate hazardous and non-hazardous wastes.	2,3	4,6,7	13
CO-3	Plan for Optimizing the route for disposal.	4,13		
CO-4	Analyze different disposal methods for bio-degradable and non-biodegradable, hazardous and non-hazardous solid wastes.	2,3,4	13	
CO-5	Design Engineered land fill for MSW and Industrial wastes.	3,4,13	6	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2	2.66	3	2.75		2	2						2.25		

Contents:

Unit-I

Introduction: Solid waste- Definition, Land Pollution - scope and importance of solid waste management, Integrated Solid waste Management, Hierarchy and future trends, functional elements of solid waste management.

Sources of solid wastes: Classification and characteristics- municipal, hospital/ biomedical waste, Quantity — Generation rate, methods. Hazardous and Non-hazardous wastes found in MSW; e-waste; C&D waste. **8Hrs.**

Unit-II

Collection and transportation: Systems of collection, collection equipment, garbage chutes, transfer stations — bailing and compacting, route Optimization, hauled contained and stationary system, Collection Routes-Guidelines for laying out routes.

Recycle and reuse: Material and energy recovery operations, reuse in other industries, plastic wastes, environmental significance, and reuse. **8Hrs.**

Unit-III

Treatment / processing techniques: Components separation, volume reduction, size reduction, chemical reduction and biological processing.
Thermal processes: Incineration - 3 Ts, factors affecting incineration process, incinerators - types, prevention of air pollution, pyrolysis. Biomedical waste. **8Hrs.**

Unit-IV

Composting: Aerobic and anaerobic composting, factors affecting composting, Mulching, Indore and Bangalore processes, mechanical and semi mechanical composting processes.
Vermi-culture Biotechnology: Environmental factors governing Vermi-culture biotechnology; Types of earthworms and their classification; Substrates for earthworms; Applications and advantages of vermicast. **7Hrs.**

Unit-V

Sanitary land filling: Definition, methods, trench area, Ramp, and pit method, site selection, basic steps involved, cell design, prevention of site pollution, collection and processes used for treatment of leachate, control methods - land fill liners, Vadose monitoring probe- gas collection systems. Closure and post closure operations.

Disposal methods: Open dumping, selection of site, Hog feeding; Sludge drying beds; Ocean disposal of solid wastes; nuclear waste disposal; Organic waste management in food process industries, case studies. **8Hrs.**

Reference Books:

1) George Tehobanoglous, “Integrated Solid Waste Management”, McGraw Hill. 2nd Edition, 2002.
2) George Tehobanoglous, Frank Kreith, “Handbook on Solid Waste Disposal”, McGraw Hill, New Delhi. 2nd Edition, 2002.
3) M S Bhat, Asheref Illiyan, “Solid Waste Management”, Synergy Books India. 2nd Edition, 2012.
4) Pandey G N Carney G C, “Environmental engineering”, Tata McGraw Hill, New Delhi. 1st Edition, 2004.

21UCVE730 Advanced Design of Steel Structures (3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs): Advanced Design of Steel Structures is taught as one of the elective courses in Civil Engineering program. In this course, topics on design of welded plate girder with and without stiffeners, gantry girder with overhead crane, roof truss (loads and forces given), member design – top chord, bottom chord, web members are dealt. The delivery of topics will be

through lecture classes using blackboard power point presentation and site visits. The evaluation will be carried out through IAs & Semester End Examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOS (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Sketch bolted beam connections-framed and seated.	3,4	1,2	
CO-2	Sketch welded beam connections-framed and seated.	3,4	1,2	
CO-3	Design plate girder.	3,4	1,2	
CO-4	Design gantry girder.	3,4	1,2	
CO-5	Design roof truss members.	3,4	1,2	

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	2	2	3	3											

Contents:

Unit-I

Bolted beam connections: Framed connection, Unstiffened seated connection, Stiffened seated connection. **7 Hrs.**

Unit-II

Welded beam connections: Framed connection, Unstiffened seated connection, Stiffened seated connection. **7 Hrs.**

Unit-III

Design of plate girder: Introduction, Basic assumptions, depth to thickness ratio of web, approximate depth of web, area of flanges, check for moment, shear, deflection, design of welded connection between web and flanges. **9 Hrs.**

Unit-IV

Design of gantry girder: Introduction impact effect, calculations of vertical moment and shear, horizontal moment and shear, selection of section, calculations of impressions flange section modulus, check for vertical and horizontal moments and shear capacities, check for biaxial moment and shear, check for deflection, check for buckling and crippling strength of web, design of welded connections between I and channel section. **8 Hrs.**

Unit-V

Design of Truss: Introduction, types, design of top chord member, design of bottom chord member, design of typical intermediate member, reversal of stresses, check for slenderness ratio, design of connections. **8 Hrs.**

Reference Books:

1) Bhavikatti S. S. "Design of Steel Structures", I.K. Publishers. 4th Edition, 2014.
2) IS:800 – 2007, "General Construction in steel: Code of practice".
3) Pramod K.V., "Steel Data Handbook", IK International, New Delhi.

21UCVE731 Hydraulics and Hydraulic Machines (3-0-0)3

Contact Hours: 39

Course learning objectives (CLOs): Hydraulic and Hydraulic Machines is taught as one of the core courses in the Civil Engineering program. In this course, topics on dimensional analysis & model testing, open channel flow design of economical sections, energy concepts of fluid in open channel, the working principles of the hydraulic machines like turbines and pumps are dealt with. The delivery of topics will be made through lecture classes. The evaluation is made by means of the internal assessment tests and semester end examination.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1,12)/ PSOs (13,15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Apply dimensional analysis technique to develop mathematical model and compute the parametric values in prototype by analyzing the corresponding model parameters.	1,2		
CO-2	Explain uniform flow in open channel and design most economical cross sections, including economical channel sections, apply energy concepts to flow in open channels and calculate specific energy.	1,2		
CO-3	Explain phenomenon of hydraulic jump, calculate sequential depths, differentiate between different types of flows.	1,2		

CO-4	Classify turbines, explain working principles of turbines, draw velocity triangles and explain various characteristics.	1,2		
CO-5	Classify pumps, define different heads, explain working principles of pumps and calculate efficiencies.	1,2		

POs	PO-1	PO-2
Mapping Level	3	3

Contents:

Unit - I

Dimensional analysis: Dimensional analysis and similitude: Dimensional homogeneity, non-dimensional parameter, Rayleigh methods and Buckingham ð theorem, dimensional analysis, choice of variables, examples on various applications. Model analysis: Model analysis, similitude, types of similarities, force ratios, similarity laws, model classification, Reynolds model, Froude's model, Euler's Model, Webber's model, Mach model, scale effects, Distorted models. Numerical problems on Reynolds's, and Froude's Model. **07 Hrs.**

Unit - II

Open Channel Flow: Uniform Flow; Introduction, Classification of flow through channels, Chezy's and Manning's equation for flow through open channel, most economical channel sections and uniform flow through open channels. Specific energy and specific energy curve, critical flow and corresponding critical parameters and metering flumes. **08 Hrs.**

Unit - III

Non-Uniform Flow: Suddenly varied flow; Hydraulic Jump, Expressions for conjugate depths and Energy loss. Gradually varied flow equation, Back water curve and afflux, Description of water curves or profiles, mild, steep, critical, horizontal, and adverse slope profiles, Control sections.

Impact of jet on vanes: Introduction, Impulse-Momentum equation. Impact of jet on stationary and moving curved vanes. Introduction to concept of velocity triangles, impact of jet on series of curved vanes- Problems. **10 Hrs.**

Unit - IV

Turbines: Impulse Turbines-Introduction to turbines, general lay out of a hydroelectric plant, Heads and Efficiencies, classification of turbines. Pelton wheel

components, working principle, velocity triangle, maximum power, efficiency and working proportions. Reaction Turbines: Radial flow reaction turbines: (i) Francis turbine Descriptions, working proportions and design. (ii) Kaplan turbine- Descriptions, working proportions and design. Draft tube theory and unit quantities. **08 Hrs.**

Unit - V

Pumps: Components and working of centrifugal pumps, Types of centrifugal pumps, Work done by the impeller, Heads and Efficiencies, Minimum starting speed of centrifugal pump, Numerical problems, multi-stage pumps. Working of different types of reciprocating pumps. **06 Hrs.**

Reference books:

1. P N Modi and S M Seth, “Hydraulics and Fluid Mechanics, including Hydraulic Machines”, 20th edition, 2015, Standard Book House, New Delhi.
2. R.K. Bansal, “A Textbook of Fluid Mechanics and Hydraulic Machines”, Laxmi Publications, New Delhi.
3. S K SOM and G Biswas, “Introduction to Fluid Mechanics and Fluid Machines”, Tata McGraw Hill, New Delhi.
4. K Subramanya, “Fluid Mechanics and Hydraulic Machines”, Tata McGraw Hill Publishing Co.Ltd.
5. Mohd. Kaleem Khan, “Fluid Mechanics and Machinery”, Oxford University Press.

21UCVE732	Water Resources Engineering	(3-0-0) 3

Contact Hours: 39

Course Learning Objective (CLOs): Water Resources Engineering is taught as one of the core courses in Civil Engineering program. Topics on Irrigation and methods of irrigation system, water requirements of crops, canals, canal works, diversion work, gravity dam, earthen dams and spillways are dealt. The delivery of topics will be made through lecture classes. The evaluation will be carried out through IAs and Semester End Exam.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	**Mapping to POs (1-12)/ PSOs (13-15)**		
	Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**

CO-1	Explain Irrigation and Irrigation systems. Calculate the water requirement of crops and to evaluate Duty, Delta and Base Period for the Crop.		1,2	
CO-2	Explain the canal system and canal works such as regulators, canal drops, and types of cross drainage works.		1	
CO-3	Understand the Diversion head work and design of impermeable floors. Reservoir planning and yield of catchment		1,2	3
CO-4	Analyze safety, modes of failure of gravity Dam.	3	2	
CO-5	Analyze earthen Dam for safety, modes of failure, understand construction methods of earthen dam and Explain importance of spillway, location of spillway, components of spillway.	3	2	1

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1.75	2	2.33												

Content:

Unit I

Irrigation and water requirements of crops: Definition of irrigation, Types of irrigation-surface and lift irrigation, advantages and disadvantages of irrigation, quality standards of irrigation water, Methods of applying water to crops for irrigation. Water requirements of crops, Duty, Delta and Base period of crop, and relation between them. Factors affecting duty of water, crop and crop seasons, Crop rotation, Irrigation efficiencies, Depth and Frequency of irrigation. Consumptive use of crops. **8 Hrs**

Unit II

Canal and canal work: Definition of gross command area, cultural command area, intensity of irrigation Types of canals, lined and unlined canals, Alignment of canals, time factor, crop factor, Standard sections of canals, Design of canals by Lacey's and Kennedy's theory. Classification and suitability of canal regulators,

Canal drop, Canal escape, Types of cross drainage works, Hydraulic principles of cross drainage works. **8 Hrs**

Unit III

Diversion work: Definition and objectives of diversion head works, Layout of diversion, components and functions of head works, Weir and barrages, Design of impermeable floors - Bligh's and Khosla's theories, Silt control works - silt ejectors and silt excluder. **4 Hrs**

Reservoir Planning: Introduction, classification of Reservoirs, Storage zones of a reservoir, Mass curve, fixing capacity of a reservoir, safe yield, problems, density currents, Trap efficiency, life of a reservoir, economic height of a dam, problems. 3 **Hrs**

Unit IV

Gravity dams: Introduction, forces on a gravity dam, stress analysis in gravity dam, Problems, combination of forces for design. Elementary & practical profiles of a gravity dam, stability analysis, problems, galleries in gravity dams. **8 Hrs**

Unit-V

Earthen Dams: Introduction, types of Earth dams, construction methods, Design criteria for Earth dams, causes of failure of earth dams, section of dam, preliminary design criteria, problems, control of seepage through earth dams, Safety measures. **4 Hrs**

Spillways: Essentials of a spillway, spillway components, factors affecting type & design of spillways. Ogee spillway (simple design problems), Energy dissipation below spillways (hydraulic jump- No design). **4 Hrs**

Reference books:

1. Modi P. N., "Water Resources and Waterpower Engineering"-. Standard book house, Delhi. 11th edition, 2019.
2. Garg S. K., "Irrigation Engineering and Hydraulic Structures" Khanna publications, New Delhi. 27th Revised Edition, 2013.
3. Punmia and Lal Pandey, "Irrigation and Waterpower Engineering" Lakshmi publications, New Delhi. 17th Edition, 2021.
4. Sharma R. K., "Irrigation Engineering and Hydraulics", S Chand Publishing; 1st Edition, January 2017.

21UCVE733	Traffic Engineering & Management	(3-0-0)

Contact Hours: 39

Course Learning Objectives (CLOs): Traffic Engineering is taught as one of elective courses for Civil Engineering Program. In this course, students are given exposure to measure various traffic flow parameters, design traffic control devices, apply statistical methods for transport planning. The delivery of topics will

be made through lecture classes and field visits. The evaluation will be carried out through IAs& SEE.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1,12)/ PSO (1,2,3)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Use Engineering science to determine the power performance of the vehicle under various resisting forces.			1,2
CO-2	Illustrate and apply traffic flow parameters to develop an efficient transport system.	1,2,3		
CO-3	Summarize the Traffic Flow theories applied to understand the traffic pattern.			1,2
CO-4	Examine the transport system problems and apply statistical methods to overcome.		1,2	
CO-5	Illustrate various traffic regulation and control devices and develop suitable traffic signal system.	1,3,12		

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	2	1.75	3									3			

Contents:

Unit - I

Definition, Objectives, Scope of Traffic Engineering. **02 Hrs**

Road User and Vehicle Characteristics: Static and Dynamic characteristics, Power performance of vehicles, Resistances to the motion of vehicles, Reaction time of driver, Problems on above **05 Hrs**

Unit - II

Traffic Parameter Studies and Analysis: Objectives and Method of study, Definition of study area, Sample size, Data Collection and Analysis Interpretation of following Traffic Studies, Volume, Spot Speed, Origin and Destination, Speed

and Delay, Parking on Street and off-Street Parking, Accidents, Causes, Analysis (right angle collision only with parked vehicle), Measures to reduce Accident, Problems. **10Hrs**

Unit - III

Traffic Regulation and Control: Vehicle and Road controls, Traffic Regulations, One Way, Traffic Signs, Traffic signals, Vehicle actuated and synchronized signals, Webster's method of signal Design, IRC Method, Problems. **07 Hrs**

Unit - IV

Traffic Island: Traffic Rotary elements and traffic operation, Relevant Problems on above. Traffic markings. **07 Hrs**

Unit-V

Probability Distribution: Poisson's Distribution and application to Traffic Engineering, Normal Distribution, Significance tests for observed Traffic Data, Chi square test, Problems on above, Sample size. **08 Hrs**

Reference Books:

1) Khanna S.K. and Justo C E G.,"Highway Engineering", Nemchand and Bros, Roorkee.
2) Kadiyali L.R.,"Traffic Engineering And Transport Planning", Khanna Publishers, New Delhi.
3) Matson,Smith and Hard., "Traffic Engineering", McGraw Hill and Co.
4) Pignataro, "Traffic Engineering", Prentice Hall.

21UCVO751	Remote Sensing and GIS	(3-0-0)3

Total Hrs: 39

Course Learning Objective (CLOs): Remote Sensing and Geographical information systems is taught as one of the Open Elective courses for Civil Engineering Program. In this course, topics on fundamentals of remote sensing platforms, sensors, introduction to GIS, GIS data models querying, analysis and cartographic output are dealt. The subject will be taught through classroom lectures and demonstration. The evaluation will be carried out through IAs & SEE.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs (1-12)/ PSOS (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Explain principles of remote sensing technology.		1	
CO-2	Explain use of remote sensing		4	1

	technology for different applications.			
CO-3	Explain GIS is and its applications	5	2	
CO-4	Identify type of data required and use the same for applications.	4	2	
CO-5	Collect, analyze the data, and prepare output in the form of maps and tables.	4	2	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	1.5	2		2.67	3										

Contents:

Unit - I

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 **7 hrs**

Unit - II

Remote Sensing Platforms and Sensors: Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensors and Properties of Digital Data, Data Formats: Introduction, platforms- IRS, Landsat, SPOT, Cartosat, Ikonos, Envisat etc. sensors, sensor resolutions (spatial, spectral, radiometric, and temporal). Basics of digital image processing- introduction to digital data, systematic errors (Scan Skew, Mirror-Scan Velocity, Panoramic Distortion, Platform Velocity, Earth Rotation) and non-systematic [random] errors (Altitude, Attitude), Image enhancements (Gray Level Thresholding, level slicing, contrast stretching), image filtering. **8 hrs**

Unit - III

Introduction: What is GIS, components of GIS, GIS Subsystems, Historical roots of GIS, Early & Current Systems, GIS Applications, Modeling Real World Features, Definition of a map, how maps convey descriptive info, how maps convey spatial relationships. **8 hrs**

Unit - IV

GIS Data Models: Spatial Data Models, Vector Data Model, Raster Data Model, Image Data Model, Vector Vs Raster Data Models, Attribute Data Models, File Structures, Database Structures, Sources of Data, Data Input Techniques, Manual Digitizing, Scanning & Vectorisation, Co-ordinate Geometry, Existing digital data, Entering attribute data, Data Verification, Errors in Spatial Data, Errors in Attribute Data , Data Editing, Interactive Graphic Editing, , Edge Match/Rubber Sheeting,

Data Organization & Storage, Vertical Data Organization, Horizontal Data Organization, Data Quality & Accuracy, Accuracy & Precision. **8 hrs**

Unit - V

GIS Analysis: Measurements, From Vector Data, From Raster Data, Accuracy, Querying Data, Spatial Selection, Logical Selection, Classification, User Controlled, Automatic Overlay Operations, Proximity Analysis, Network Analysis, Cartographic Output, Layout design, Symbology, Vector Display Devices, Raster Display Devices. **8 hrs**

Reference Books:

1. Lillesand, T., Kiefer, R. W., & Chipman, J. "Remote sensing and image interpretation," John Wiley & Sons. 7th Edition, (2015).
2. Jensen, J. R., "Remote Sensing of the Environment: An Earth Resource Perspective," Pearson Education India, 2nd edition, (2013).
3. Jensen, J. R., "Introductory Digital Image Processing - A Remote Sensing Perspective," Pearson Education, Fourth edition, (2017).
4. Chang, K.T., "Introduction to Geographic Information Systems," McGraw Hill Education (India) Private Limited, Ninth edition, (2020).
5. Kumar, D. N., A NPTEL Course on "Remote Sensing: Introduction and basic Concepts," https://nptel.ac.in/courses/105108077

VIII Semester

21UCVL800	Technical Seminar	(0-0-2) 1

Contact Hours:26

Course Learning Objective (CLOs): In this course, students will collect information on current issues being practiced in different fields of Civil Engineering like Structural Engineering, Water Resources, Geotechnical Engineering, Environmental Engineering, Transportation Engineering etc. by referring journals and other online sources leading to a comprehensive study of the topic selected. Students may also visit field for collection of data or any kind of validation the chosen study topic requires. The evaluation will be carried out through presentation and viva-voce.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs (1-12)/ PSOs (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Identify a topic relevant to Civil Engineering on recent development/ case studies.	4	1,2,5	12
CO-2	Carry out the literature review.	4	1,2,5	12
CO-3	Compile data by direct and indirect methods.	9	1,2	12
CO-4	Organize the data and prepare report.	4,9	1,2,5	12
CO-5	Defend the presentation.	4,9	1,2,5	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2	2		3	2				3			1			

Technical Seminar: The students are expected to learn how to carry out literature survey to locate the state-of-the-art technology in engineering domain of their interest. They are required to carry out selection of an emerging topic beyond the syllabus relevant to the branch of study, understand the concept, analyze and present effectively for 15-20 minutes followed by 5 minutes of questions and answers before their classmates and faculty. They can also present the technical

innovative/novel work carried out in the laboratory. Students are also required to learn the effective communication and modalities of technical interactions.

21UCVL801	Major Project Phase - 2	(0-0-18) 9

Total Hrs:234

Course Learning Objective (CLOs): Project Phase-II is carried out under the guidance of a faculty. In this course, the students will analyze the data collected, interpret the results, draw conclusions, design project components, evaluate/ assess the project and redesign if necessary, following relevant codes/ standards of practice, if applicable. The evaluation will be carried out through presentation and viva-voce.

Course Outcomes (COs):

ID	Description of the Course Outcome: At the end of the course the student will be able to:	Mapping to POs (1-12)/ PSOs (13-15)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Analyze and interpret the data collected and draw conclusions.	9,13,14,15	3,4	8,11,12
CO-2	Design different components of the project following relevant IS codes if applicable.	9,13,14,15	3,4	8,11,12
CO-3	Evaluate and redesign if required.	9,13,14,15	3,4	8,11,12
CO-4	Prepare project report.	9,13,14,15	3,4	11
CO-5	Defend the presentation.	4,9	1,2,5	

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Mapping Level	2	2	2	2.2	2			1	3		1	1	3	3	3

Major project phase-2 is the continuation from phase –I. The same project team formed for phase –I will continue the work under the guidance of the same faculty member. A committee consisting of a minimum of 3 faculty members of which guide is a member shall evaluate at the end for CIE. There is a viva voce examination which shall be examined by two examiners, one internal and one external to the college appointed by COE based on the suggestions by the respective HoD.

21UCVL802	Internship - 2	(0-0-4) 3

Duration: 4-6 Weeks

Course Learning Objective (CLOs):

1. The purpose of internship is student should be able to learn how to apply the knowledge acquired during internships in his future workplace.
2. The student should demonstrate to work in the interdisplinary approach and in a team with good communication skills.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1-12)/ PSOs (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify and define the problem.	13	1	9,12
CO-2	Will collect data by direct and indirect methods.	2	13	9,12
CO-3	Collect required literature survey and organize them.	1		9,12
CO-4	Formulate the methodology	2	2	9,12
CO-5	Conduct required experiment.		15	9,12
CO-6	Interpret the data/ results, draw conclusions and suggest strategies.	15	5	9,12

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	2.5	2.66							1			1	2.5		2.5

Internship: The students are to undergo internship in Private industries/ R&D organizations/Centres of Excellence/Laboratories of Reputed Institutions/ Govt. & Semi Govt. organizations, PSUs, construction companies, entrepreneurial organizations, inter departments within the college etc. to get an exposure to the external world for a period of 4 weeks in the summer vacation after VI sem and before start of VII semester. The students are to prepare a report on the internship work carried out. The internal faculty shall monitor the student and award CIE marks. There is a SEE in which the student shall present his work before a panel of examiners consisting of HoD, Guide and one faculty member during VIII semester. The performance shall be communicated to the CoE office and the same shall reflect in the VIII semester grade card.