Academic Program: UG

Academic Year 2023-24

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 2023-24 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 commitment and quality, timeliness with continuous improvement.

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

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY DHARWAD

Department of Civil Engineering

Seventh Semester

Scheme of Teaching and Examinations 2023-24

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.
18UCVC700	PC	Wastewater Engineering	4 - 0 - 0	4	50	100	3	-	-
18UCVC701	PC	Design of Steel Structures	4 - 0 - 0	4	50	100	3	-	-
18UCVE7XX	PE	Program Elective-4	3 - 0 - 0	3	50	100	3	-	-
18UCVO7XX	OE	Open Elective 2	3 - 0 - 0	3	50	100	3	--	--
18UCVL702	PC	Major Project Phase-1	0- 0 -4	2	50	--	--	50	3
18UCVL703	PC	Internship	4 w e e k s	2	50	--	--	50	3
18UCVL704	PC	Environmental Engineering Laboratory	0 - 0 - 2	1	50	--	--	50	3
		Total	**14 - 0 - 6**	**19**	**350**	**400**		**150**	

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

List of Elective Courses

Course Code	Course Title
18UCVE714	Advanced design of RC Structures
18UCVE715	Introduction to Bridge Engineering
18UCVE716	Structural Dynamics
18UCVE718	Advanced Foundation Design
18UCVE724	Construction Contract Management
18UCVE725	Earthquake resistant structures
18UCVE726	Construction Equipment and Management
18UCVE727	Design of Prestressed Concrete Structures
18UCVE728	Urban Transport Planning

List of Open Elective Course (For all branches)

Course Code	Course Title
18UCVO701	Introduction to law for Engineers
18UCVO702	Road safety and traffic management

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.

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY DHARWAD

Department of Civil Engineering

Eighth Semester

Scheme of Teaching and Examinations 2023-24

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.
18UCVC800	PC	Water resources Engineering	4 - 0 - 0	4	50	100	3	-	-
18UCVE8XX	PE	Program Elective-5	3 - 0 - 0	3	50	100	3	-	-
18UCVO8XX	OE	Open Elective 3	3 - 0 - 0	3	50	100	3	--	--
18UCVL801	PC	Technical Seminar	0 - 0 - 2	1	50	--	--	--	--
18UCVL802	PC	Major Project Phase-2	0 - 0 -12	7	50	--	--	50	3
	Total		**10 – 0 - 14**	**18**	**250**	**300**	**--**	**50**	**--**

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

List of Elective Courses

Course Code	Course Title
18UCVE818	Principles and Practice of Construction Project Management
18UCVE819	Ground Improvement Techniques
18UCVE825	Design of Reinforced Concrete Bridges
18UCVE826	Solid Waste Management
18UCVE827	Air Pollution and Control
18UCVE828	Advanced Design of Steel Structure

List of Open Elective Course (For all branches)

Course Code	Course Title
18UCVO801	Remote Sensing and 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.

18UCVC700	Wastewater Engineering	(4-0-0) 4

Contact Hours: 52

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. 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. **10 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, flushing tanks, oil and grease traps, drainage traps, basic principles of house drainage, typical layout plan showing house drainage connections, maintenance of house drainage. **10 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. Sampling, significance, techniques and frequency.

Sewage Pumping: Need, types of pumps, design of pumps and pumping stations. **10 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, chlorination of sewage. **10 Hrs**

Unit - V

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

Miscellaneous Treatment Methods: Septic tanks, oxidation ponds – design. Introduction to RBC, UASB, anaerobic filters. **12 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.

18UCVC701	Design of Steel Structures	(4-0-0)4

Contact Hours: 52

Course Learning Objectives (CLOs): Design of steel structures is taught as a core course in Civil Engineering program. In this course, topics on steel connections-bolted and welded, tension members, truss ties, lug angles, compression members, struts, columns, built-up column sections, laced columns, battened columns, column splices, slab bases, gusseted bases and beams are dealt, based on limit state method of design. The delivery of topics will be through lecture classes using black board & PPT and site 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	Define design stresses in structural steel and fasteners as per IS:800-2007 and analyze / design of Bolted connections.	3,4		
CO-2	Analyze / design welded connections and design tension members with bolted or welded end connections.	3,4		
CO-3	Analyze / design simple and built-up compression members and column splices.	3,4		
CO-4	Design lacing and battening systems for built-up columns and column bases.	3,4		
CO-5	Analyze / design laterally supported beams subjected to low and high shear by Plastic Analysis method as per IS:800-2007.	3,4		

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

Contents:

Unit - I

Introduction: Advantages and disadvantages of Steel structures, Loads and load combinations, Structural forms, Discussions of design concepts. IS code provisions.

Structural Fasteners: Bolted connections, strength of bolts, design of bolted connections, lap joints and double cover butt joints, analysis and design of bolted bracket connections. **10 Hrs**

Unit - II

Welds: Fillet and Butt welds — Strength and design of connections, analysis and design of welded brackets- type1 and type2.

Design of Tension Members: Axially loaded tension members and their connections, design of lug angles-Comparison, Design of truss ties-Single and Double Angle- and joints **12 Hrs**

Unit - III

Design of Compression Members: Effective length, Radius of gyration, Design Compressive Stress, Single and Double Angle struts, I-Section Columns, Built-up Columns, I-Sections with Cover Plates on Flanges.

Column splicing: Type-1 and Type-2 **10 Hrs**

Unit - IV

Double Channel Built-up Column: Back-to-Back / Toe to Toe- Laced and Battened systems.

Steel Foundations: Column bases-simple slab-base, gusseted base. **10 Hrs**

Unit - V

Design of beams: Introduction to Plastic Analysis, Plastic Section Modulus, Low Shear and High Shear Beams, moment of resistance of low shear and high shear beam as per IS 800:2007.

Design of Laterally supported beams: Low and High shear Beams, Built-up Beams **10 Hrs**

Reference Books:

1) N Subramanian, “Steel Structures: Design and practice”, Oxford Publishers. 2018.
2) Bhavikatti S.S., “Design of Steel Structures”, I.K. Publishers. 5th Edition, 2019.
3) IS 800: 2007, “Code of construction – Steel Structures”, BIS.
4) Pramod K.V., “Steel Data Handbook”, I.K. International, New Delhi.

18UCVL702	Major Project Phase – I	(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

18UCVL703	Internship	(0-0-4) 2

Duration: 4 Weeks

Course Learning Objective (CLOs): Internship is carried out in a construction company/ organization/ Civil Engineering Department of State or Central Governments with well-defined scope and objectives. Students during their vacation at the end of their VI semester will approach a construction company/ organization/ industry/ Relevant Government Departments/ PSUs and will undergo internship. During this process, they finalize the objectives, scope, formulate methodology, collect the required data, interpret the data/ results, draw conclusions, and suggest strategies under the guidance of a supervisor/ representative of the industry. They present the study in the form of an internship report under guidance of the faculty member during their VII semester.

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

18UCVL704 Environmental Engineering Laboratory (0-0-2)1

Contact Hours: 36

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: 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	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

Mapping level: 1 = Low, 2=Moderate, 3=Substantial

Prerequisites:

Students taking this course shall have the knowledge of following:

1) Engineering Chemistry.
2) Water supply engineering.

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.

18UCVE714 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 wall and foundations.		2,13	1
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 portal frame (single bay, single storey). **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”.

18UCVE715 Introduction to Bridge Engineering (3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs): Introduction to Bridge Engineering is taught as one of the elective courses in the Civil Engineering program. In this course, basics of reinforced concrete, PSC and steel bridges, linear waterway, scour, afflux, loadings on highway and railway bridges, stability of abutments and piers, types of bearings, types of foundations and concepts of load distributions in bridges are dealt. 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	Summarize and appreciate basic concepts in selection of type of bridge for a given geography, functions of components of bridges.	1, 2		
CO-2	Plan and design linear waterway, economic span for a bridge,	1, 2	3	

CO-3	Define standard loadings and identify loads on bridges. Define and distinguish different types of bridge bearings.	1, 2		
CO-4	Select suitable foundation, analyze abutments/piers,	1, 2,3		
CO-5	Select type of wing wall, design pipe culverts.	3		

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

Contents:

Unit - I

Introduction: Components of Bridges, classification of bridges, masonry, arches, RCC, PSC, Steel and composite, brief description of different types and proportionate sketching, preliminary design principles. **8 Hrs.**

Unit - II

Investigation: Site selection criteria, collection of design data, road, stream, surrounding area, etc.

Preliminary Calculations (Equations only): Linear waterway, afflux, economic span, scour depth, determination of flood discharge. **8 Hrs.**

Unit - III

Standard Loadings: IRC and Railway loadings, equivalent loadings for preliminary design.

Bearings: Metallic, Concrete and Elastomeric bearings - types & sketches. **8 Hrs.**

Unit - IV

Foundations: Depth of foundation - Scour effect, types of foundation, Pile, Raft, Well, Caisson - sketches and brief description, Cofferdams.

Substructure: Abutments, piers, forces acting on them, stability consideration. **8 Hrs.**

Unit - V

Wing walls: Types (sketches), Splay, Batter, Returns.

Design of Pipe Culvert: Design with final detailed sketch. **7 Hrs.**

Reference Books:

1) Victor D.J. and Johnson, “Essentials of Bridge Engineering”, Oxford and IBH, 6th Edition 2017.
2) Bindra S.P., “Bridge Engineering”, Dhanpat Rai Publications, 5th Edition, 1996.
3) IRC: 6 – 2017, “Standard Specifications and Code of Practice for Road Bridges”

4) IRC: 21 – 2000, “Standard Specification and Code of Practice for Road Bridge”.

18UCVE716	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 program. 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 un-damped systems.	1,2	3	
CO-2	Explain Harmonic loading case and vibration isolation system for SDOFS.	1,2	3	
CO-3	Analyze the Multi storey shear building under free and forced vibration for damped and un-damped conditions.	1,2	3	
CO-4	Explain the effect of impulse load using Duhamel’s Integral.	1,2	3	
CO-5	Apply the knowledge of Fourier series in structural dynamics.	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, seismic instruments, generalized single degree of freedom system (rigid body and distributed elasticity). **8 Hrs**

Unit - III

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 its types. **8 Hrs**

Unit - IV

Impulse load using Duhamel's integral: Response to general dynamic loading, Impulsive loading and Duhamel's integral, numerical evaluation of Duhamel's integral, un-damped system, numerical evaluation of Duhamel's integral. **7 Hrs**

Unit - V

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

18UCVE718	Advanced Foundation Design	(3-0-0)3

Contact Hours: 39

Course Learning Objective (CLOs): Advanced Foundation Design is taught as one of the elective courses for Civil Engineering program. In this course, design of shallow foundations, deep foundations such as piles, piers, caissons, well foundations and the effect of dynamic loads on foundations are dealt. The delivery of the topics is achieved 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 bearing capacity and factors affecting it; calculate the dimensions of shallow foundations based on bearing capacity.		1,2	3
CO-2	Explain necessity and classification of piles, negative skin friction, calculate load bearing capacity, efficiency and settlement of single pile and pile group, explain pile load test, under reamed piles.		1,2	3
CO-3	Explain drilled piers, construction, design aspects of caissons, explain shapes, characteristics, components, sinking of wells, causes and remedies of tilts and shifts.		1,2	3
CO-4	Explain the expansive soils, identification methods, construction and treatment of foundations.		1,2	
CO-5	Explain design aspects of foundations for special structures such as antenna/ transmission line towers/ tall chimneys.		1,2	3

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

Contents:

Unit - I

Shallow foundations: Presumptive bearing capacity according to BIS, factors affecting bearing capacity and settlement, factors influencing selection of depth of foundation, types of shallow foundations – isolated footing. Combined footing, strap footing, strip footing and raft. **8Hrs**

Unit - II

Pile foundations: Necessity, classification, load bearing capacity by static and dynamic formula, pile load and penetration tests, pile groups – group capacity of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction, under-reamed piles. **9Hrs**

Unit - III

Drilled piers and caissons: Introduction, construction, advantages and disadvantages of drilled piers. Design of open, pneumatic and floating caissons. Advantages and disadvantages of floating caissons.

Well foundation: Different shapes and characteristics of wells. Components of well foundation. Forces acting on well foundation. Sinking of wells. Causes and remedies of tilts and shifts. **7Hrs**

Unit - IV

Foundations in expansive soils: Definition, Identification, index properties, swell potential, swell pressure, free swell, CNS layer, foundation treatment for structures. **8Hrs**

Unit - V

Design of special foundation: Design aspects of foundation for antenna and transmission line towers, tall chimneys. **7Hrs**

Reference Books:

1) Murthy V.N.S., “Soil Mechanics & Foundation Engineering”, CBS Publishers, 3rd edition, 2018.
2) Bowles J.E., “Foundation Analysis and Design”, McGraw Hill Pub. Co., New York, 5th edition, 1996.
3) Purushotham Raj P, “Soil Mechanics & Foundation Engineering”, Pearson Education Ltd Publishers, 2nd edition, 2016.
4) IS 2911: 2010 - Design and Construction of Pile Foundations - code of practice, part 1: concrete piles, section 1: driven cast in-situ concrete piles.

18UCVE724	Construction Contract Management	(3-0-0)3

Contact Hours: 39

Course Learning Objective (CLOs): Construction Contract Management is taught as one of the elective courses in Civil Engineering program. In this course, silent features of Indian Contract Act, general conditions of contract for domestic and international works, aspects related to contract administration and laws applicable to construction industry, dispute resolution techniques are dealt. The delivering 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	Understand Indian legal system and how it affects construction industry, Indian Contracts Act and its application to construction industry.	6		
CO-2	Explain features of contract, essentials of a valid contract, general conditions of contract, domestic, international contracts and their comparative study.	6		
CO-3	Explain various aspects related to administration of contract.	8		
CO-4	Explain various laws applicable to Indian Construction industry.	6		
CO-5	Evaluate various dispute resolution techniques and evolve strategies for dispute minimization.	8	4	9

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

Course Content:

UNIT I

Introduction to legal system: Introduction and controls it exerts on the activities of engineers and managers in practice.

Indian Contract Act 1872: Salient features of Act and its applicability to construction industry. **8 Hrs**

UNIT II

Contracts: Definitions, salient features of a contract, essentials for a legally valid contract, documents for an engineering contract.

General conditions of contract: Domestic - CPWD and International Contract – FIDIC; Special conditions of contract; Comparative study of contract conditions. **8 Hrs.**

UNIT III

Contract Administration: Performance / Discharging of a contract, Obligations of Employer and contractor, Breach of contract - Definition and Classification, Common Breaches by – Employer, Contractor.

Delay and extension of time, extras, variation in quantity, price escalation. Construction claims and their management: Claims for Damages and liquidated damages; Quantum Meruit, Force Majeure. **8 Hrs.**

UNIT IV

Laws applicable to construction activity: Need and broad provisions of following Acts including important case laws.

The Building and Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996; Industrial Disputes Act, 1947; Workmen's Compensation Act, 1952; Employers' Liability Act, 2008; Payment of Wages Act, 1936; The Employees Provident Fund, 1952; Contract Labor (Regulation and Abolition) Act, 1970; Minimum Wages Act, 1948; Interstate Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979. **8Hrs**.

UNIT V

Disputes and Resolution Techniques: Methods for dispute resolution − Negotiations, Mediation, Conciliation, Dispute Resolution Boards, Arbitration, Arbitration and Conciliation Act 1996: Act of 1996 and Arbitration Case Studies. Litigation / Adjudication by courts, Approach to dispute minimization. **7 Hrs**.

Reference Books:

1) Markanda P. C., "Building and Engineering Contracts, Vol 2", LexisNexis, Butterworths, Wadhwa, Nagpur, 5th Edition, 2017.

2) Kishor Gajria, "G.T. Gajria's Laws relating to Buildings and Engineering Contracts in India", LexisNexis, 4th Edition, 2000.

3) Jimmie Hinze, "Construction Contracts", McGraw Hill, 3rd Edition, 2010.

4) Joseph T. Bockrath, "Contracts and the Legal Environment for Engineers and Architects", McGraw Hill, 7th Edition, 2010.

5) Anupam Kurlwal, "An Introduction to Alternative Dispute Resolution System (ADR)", Central Law Publications, Allahabad,3rd Edition, 2017.

6) Government of India, "CPWD Works Manual 2014".
7) General Conditions of Contract, Central Public Works Department 2014, New Delhi.
8) "Conditions of Contract for Construction for Building and Engineering Woks Designed by the Employer", FIDIC, 1999.
9) Bare Acts: Indian Contract Act, Arbitration Act and other relevant Acts.

18UCVE725	**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.

18UCVE726 Construction Equipment and Management (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 improvements of safety at site.	6	8	12

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.

18UCVE727 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”.

18UCVE728	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 delivering 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.

18UCVO701	Introduction to Law for Engineers	(3-0-0)3

Contact Hours: 39

Course Learning Objective (CLOs): Law for Engineers is taught as one of open elective courses for Engineering Program. In this course, Law of Tort, and important laws pertaining to Business Law, Corporate Law, Banking law and Workplace Law with reference to definition, provisions, applicability, enforcement and remedy are dealt. The delivering 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 PO (1-12)/ PSO (13-15)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Understand definition, elements, nature, general principles, liability of state, and remedy of Law of Torts including specific torts and its		6	8

	application to consumer protection.			
CO-2	Comprehend Indian Contract Act of 1872. Understand The sale of Goods Act of 1930. Understand the Competition Act of 2002.	6		8
CO-3	Comprehend The Companies Act of 2013 and Understand the Information Technology act of 2000.	6		8
CO-4	Understand definitions, various provisions, applicability and enforcement of The Negotiable Instruments Act, Banking Regulation Act, The Securitization and Reconstruction of Financial Assets and Enforcement of Security Interest Act, Prevention of Money Laundering Act.		6	8
CO-5	Understand definitions, various provisions, applicability, and enforcement of Law of Industrial Disputes. The Shops and Establishment Act, The Maternity Benefit Act, Sexual Harassment of Women at Workplace, Introduction to Labour Codes			6,8,9

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

Contents:

Unit I

Law of Tort: Definition, Elements and nature of torts, General Principles of Law of Torts, Liability of State in Tort, Damages as remedy in Tort, Specific torts and its application to consumer protection. **8 Hrs**

Unit II

Business Law: Indian Contract Act of 1872: General principles the Act (section 1 to 75), essentials of a valid contract, performance of contract, breach of contract, contingent and quasi contract.

The sale of Goods Act of 1930: Formation of contract of sale, conditions and warrantees, transfer of ownership and delivery of goods, unpaid seller and his rights.

The Competition Act of 2002: Definition and meaning, anti-competitive agreements and abuse of dominant position, breach, enforcement of law, Competition Commission of India and the Competition Appellate Tribunal. **8 Hrs**

Unit III

Corporate Law- The Companies Act of 2013: Corporate personality and its kinds, promoters, Registration and Incorporation - MOA, AOA, Prospectus, Directors, Meetings, Role of Company Secretary, Dividends, Issue of Shares, types of shares, debentures, procedure for allotment of shares and debentures, share capital, rights and privileges of shareholders, preventions of oppression and mismanagement, different modes of winding up of companies.

The Information Technology Act of 2000: Need, Objectives, Application, Important provisions, Offences and penalty under the Act. **8 Hrs**

Unit IV

Banking Law: The Negotiable Instruments Act of 1881, Banking Regulation Act of 1949, The Securitization and Reconstruction of Financial Assets and Enforcement of Security Interest Act of 2002, Prevention of Money Laundering Act of 2002. **8Hrs**

Unit V

Workplace Law - Law of Industrial Disputes Act of 1947, The Maternity Benefit Act of 1961, The Minimum Wages Act of 1948, The Employees Provident Fund Act of 1952, The Shops and Establishment Act of 1953, Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act of 2013. Labour Codes on: Wages, Social Security, Industrial Relations, Occupational Safety, Health and Working Conditions. **7 Hrs**

Note: If new legislation is enacted in place of existing legislations, the syllabus would include corresponding provisions of such new legislations with effect from the date notified by the institute.

Reference Books:

1. Anirudh Wadhwa, 'Mulla: Indian Contract Act', LexisNexis. 16th Edition, 2021.
2. J.N. Pandey, 'Law of Torts (With Consumer Protection Act and Motor Vehicles Act)', Central Law Publications, Allahabad. 10th Edition, 2019.
3. Avtar Singh, 'Company Law', Eastern Book Company, Lucknow. 17th Edition, 2018.
4. Kondaiah Jonnalagadda, 'Securities Law', LexisNexis. 1st Edition, 2015.
5. Kandasami K.P, Natarajan S & Parameswaran, 'Banking Law and Practice', S Chand, New Delhi. 4th Edition, 2015.

Bare Acts on all laws mentioned in the syllabus.

18UCVO702	Road Safety and Traffic Management	(3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs): Road Safety and Traffic Management is taught as one of open elective course for Civil Engineering Program. In this course, students are given exposure to measure various aspects of road safety management viz. Accident Analysis, Road Safety Auditing, and various aspects of traffic management viz. Highway capacity, ITS and PPP in highway project. 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	Identify the blackspot and analysis the causes of road accidents.			1,2
CO-2	Carry out road safety auditing across national highway stretch.	1,2,3		
CO-3	Provide first-aid to the accident victims.			1,2
CO-4	Analysis highway capacity at signalized and unsignalized intersection for mixed traffic condition.		1,2	
CO-5	Summarize various traffic management system and financial viabilities of Public-Private Partnership.	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

1. Definition, Objectives, Scope of Road Safety Management. **02 Hrs**

2. **Road accidents**, Causes, Scientific Investigations and Data Collection, Analysis of Individual Accidents to Arrive at Real Causes; Collision Diagram, Condition Diagram, Blackspot-Identification and Rectification. **05 Hrs**

Unit - II

1 **Road Safety Audit: -** Principles- Procedures and Practice, Code of Good Practice and Checklists. Road Safety Issues and Various Measures through Engineering, education and enforcement measures for improving road safety.

09 Hrs

Unit - III

1. **Road Safety Management:** First Aid to Accident Victims: First aid techniques, Coordination with hospitals for treatment, Role of insurance companies in providing aid to accident victims.
2. **Motor Vehicle Act 1988 and 2019**: Registration and Licensing Authorities in India: Powers and Duties, Classification of Traffic Offences. Penalties and appeals. **07 Hrs**

Unit - IV

1. **Design Hourly Volume for Varying Demand Conditions:** Concept of Design vehicle units and determination of PCU under mixed traffic conditions, Determination of design hourly volume; critical hour concept.
2. **Highway Capacity**: Factors affecting capacity, level of service; Capacity studies Capacity of different highway facilities including unsignalized and signalized intersections
3. **Intelligent Transport System:** Introduction, Application, ITS in various cities.

08 Hrs

Unit - V

1. **Traffic Management:** Transit System, Cycle Track, Paratransit, Mass Rapid Transit System, Freight Management, safety practices during road works**.**
2. **Public-Private Partnership in Transport Projects:** Benefits from privatization, Forms of Privatization, Government Incentives, Financial Viability of Privately Funded Project. **08 Hrs**

Reference Books:

1) Khanna S.K. and Justo C E G., “Highway Engineering”, Nemchand and Bros, Roorkee, Revised Tenth Edition, 2017.

2) Kadiyali L.R.,“Traffic Engineering And Transport Planning”, Khanna Publishers, New Delhi, Ninth Edition, 2017.

3) Leonard Evans., “Traffic Safety, Science Serving Society”, Revised Second Edition, 2006.

4) IRC: SP-88-2010, “Road Safety Audit Manual”, Indian Roads Congress, New Delhi, India, 2010.

5) IRC: SP-44-1996. “Highway Safety Manual”, Indian Roads Congress, New Delhi, India, 1996.

8th Semester

18UCVC800	Water Resources Engineering	(4-0-0) 4

Contact Hours: 52

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												

Course 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. **10 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. **10 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. **7 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. **5 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. **10 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. **5 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). **5 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.

18UCVL801	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.

18UCVL802	Major Project Phase-II	(0-0-12) 7

Total Hrs:100

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.

18UCVE818	Principles and Practice of Construction Project Management	(2-0-2) 3

Contact Hours:39

Course Learning Objectives (CLOs): Principles and Practice of Construction Project Management is taught as one of the elective courses in Civil Engineering program. In this course, various concepts of construction project management viz. planning, scheduling, resource analysis, optimizing and executing are dealt. Practical training using project management software is imparted. The course is taught through lecture classes and computer laboratory practical. 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 construction projects, project management techniques, planning and scheduling principles, methods of scheduling.			1,11
CO-2	Create a network schedule, CPM and PERT Network diagram for a construction project using the defined rules.		3,11	
CO-3	Understand costs and Resources of a construction project and to effect Resource smoothing, leveling and updating of the Project.			11
CO-4	Create a project, build a work break down structure, add activities and create relationships.	3,11		
CO-5	Assign resources, analyze schedule dates, resource allocation, execute the project plan and create reports.	4,9		

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Mapping Level	1		2.5	3					3		1.75				

Contents:

Unit - I

Introduction: Introduction to Construction Projects and Project Management, Project Phases & Life Cycle of a Project. Introduction to Project management techniques- CPM, PERT and Project Management Software.

Planning and Scheduling for Construction Projects: Introduction, Steps involved in Planning, Objectives, Principles and Advantages of Planning, Preparation of construction schedules, Uses and advantages of scheduling, Methods of scheduling – Bar charts, Milestone charts, Job lay out, Work break down structure, Line of balance technique. **7L hrs**

Unit - II

Project Management through Networks: Introduction and definition of a network, Objectives, Interrelationship of events, Interrelationship of activities, Types of networks, Assumptions for creating a network schedule, Rules for drawing a network. Fulkerson's rule.

Program Evaluation and Review Technique (PERT): Introduction, Time estimates, earliest expected time, Latest allowable occurrence time, Tabular format and computations, Slack, Critical path, Probability of completion time for a project. **9L hrs**

Unit - III

Critical Path Method (CPM): Introduction, Difference between CPM and PERT, Earliest and latest event times, Activity time, Float, Criticality and critical activity, Tabular format and computations

Time: Cost Relationship and Resource Allocation: Introduction, Direct costs, Indirect costs, Total Project costs, Optimization of cost through network contraction, Resource smoothing and leveling, Project updating. **9L hrs**

The following chapters under Unit no's - IV & V shall have Laboratory Practical using Project Management software.

Unit - IV

Structuring of the Project: Create a Project, Describe the Enterprise Project Structure (EPS),Set up and understand the Organizational Breakdown Structure (OBS), Set up User Preferences, Navigate in the Project window, Modify Project Information, Create a Work Breakdown Structure (WBS) and Multiple levels of WBS hierarchy, Understand Activity types, Describe Activity components, Add activities, Set up Project Parameters, Assign Project Codes, Resource Codes, Activity Codes, Modify activity Information.

Scheduling and Resource Management of the Project: View Network logic diagram, Apply activities relationships (Logical connection), Describe Relationship Types, Scheduling, Describe the Forward and Backward Pass, Understand Total Float, Calculate schedule, Assign constraints, Describe and Apply activity level Constraints, Format schedule data, Create layouts, Utilize grouping, sorting and

filtering, Understand Resource types, Assign Resource to activities, Analyze and resolve resource over allocation. **7P hrs**

Unit - V

Optimizing and Executing of the Project: Optimize the Project Plan- Analyze schedule dates, Shorten the Project Plan, Analyze Resources and Cost, create a Baseline Plan, Assign the baseline to the Project, Display baseline bars in the Gantt chart, Project Execution- Describe methods of applying Progress, Progress Update, Update activity information, Set up Project Thresholds, Level the Project Resources, Project Tracking.

Reporting: Reporting- Describe available Reporting Methods, Run a schedule Report, Procurement Report, Project Progress Report, Schedule Comparison Report, Weekly Report, Project Cost Report, Project Closing Report, Client Report. **7P hrs**

Reference Books:

1) Chitkara, K.K.," Construction Project Management: Planning, Scheduling and Control", McGraw Hill Publishing Company, New Delhi, 1998. 3rd Edition, 2014.

2) S. Seetharaman, "Construction Engineering and Management", Umesh Publications, Delhi,2005. 5th Edition, 2017.

3) Feigenbaum, L.," Construction Scheduling with Primavera Project Planner", Prentice Hall Inc. 2nd Edition, 2001.

4) Raina V.K., "Construction Management Practices: The inside story", Tata McGraw Hill Publishing Company Ltd. New Delhi 1998. 2nd Edition 2009.

5) Project Management Software and relevant user manuals.

18UCVE819	**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.

18UCVE825	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".

18UCVE826	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 recognize the possible health hazards of their disposal.		1, 2	-
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	4,13		

	disposal.			
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.

18UCVE827 Air Pollution and Control (3-0-0)3

Contact Hours: 39

Course Learning Objective (CLOs): Air pollution and Control is taught as one of elective courses for Civil Engineering Program. In this course, topics on air pollutants, effects on man and surroundings, meteorological variables and their effects, sources of pollutions, sampling, measurement, analysis and design of control methods of air pollution. The delivery of topics will be made through lecture classes and demonstrations. The evaluation will be carried out through IAs and Semester End Examination.

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	Classify air pollutants, identify their sources and describe their effects on		2	

	environment, man, material & vegetation.			
CO-2	Discuss sampling methods for air pollutants and relevant standards & legislations for air pollution control.	4	6	9
CO-3	Predict changes in atmosphere by meteorological variables and their effects.		5	
CO-4	Analyze and design air pollution control methods for gaseous and particulate matter.	15	3	
CO-5	Analyze air pollution due to automobiles, global effects of air pollution and EIA.		10	

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

Contents:

Unit - I

Introduction: Definition - Classification and properties of air pollutants, primary and secondary air pollutants, concentrations of air pollutants and sources, behavior and fate of air pollution: Chemical reaction in the atmosphere, photochemical smog.

Effects of air pollution: On human health, animals, plant and properties, major Episodes. 8**Hrs.**

Unit - II

Sampling and analysis of air pollutants: Sampling and measurement of Gaseous and particulate pollutants stack sampling, smoke and its measurements.
Standards and legislation: Air quality and emission standards-legislation and regulation. Air pollution index. **7 Hrs.**

Unit - III

Meteorology: Introduction - Meteorological Variables. Lapse Rate, Adiabatic Dispersion/ inversion, Stability Conditions, windrose, General characteristics of stack plumes**.** **8 Hrs**

Unit - IV

Control of air pollutants: Control methods - Particulate emission control, gravitational settling chambers, cyclone separators, fabric filters, Electrostatic precipitators, wet scrubbers, control of gaseous emissions. **8 Hrs.**

Unit - V

Air pollution due to automobiles: Air pollution due to gasoline driven and Diesel driven engines, effects, control-direct and indirect methods.

Global environmental issues: Acid rain, Green House effect, Global warming, Ozone layer Depletion, Environmental Impact Assessment in industrial plant locations and planning **8 Hrs**

Reference Books:

1) Rao M.N., "Air Pollution", Tata McGraw Hill Education. 1st Edition, 2017.
2) Rao C.S., "Environmental pollution control", Wiley Eastern Ltd. 3rd Edition, 2018.

18UCVE828	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 black board 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.

18UCVO801	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 technology for different applications.		4	1
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