SCHOOL OF ENGINEERING AND TECHNOLOGY

Program and Course Structure

M. Tech. (Civil Engineering) with specialization in Structural Engineering/Environmental Engineering/Geotechnical Engineering/Construction Management

Program Code: SET0310

Batch: 2020-22

1. **Vision, Mission and Core Values of the University**

Vision of the University

To serve the society by being a global University of higher learning in pursuit of academic excellence, innovation, and nurturing entrepreneurship.

Mission of the University

1. **Transformative educational experience.**
2. **Enrichment by educational initiatives that encourage global outlook.**
3. **Develop research, support disruptive innovations and accelerate entrepreneurship.**
4. **Seeking beyond boundaries.**

Core Values

- **Integrity**
- **Leadership**
- **Diversity**
- **Community**

1.1 Vision and Mission of the School

Vision of the School

To become a globally acclaimed institution of higher learning in engineering and technology promoting excellence in research, innovation and entrepreneurship to provide sustainable solution to the needs of the society.

Mission of the School

1. **To impart quality education with strong industry & academic connectivity in the expanding fields of Engineering and Technology in a conductive and enriching learning environment.**
2. **To product technocrats equipped with technical & soft skills and experiential learning required to stay current with the modern tools in emerging technologies to fulfil professional responsibilities and uphold ethical values.**
3. **To inculcate a culture of interdisciplinary research, innovation and entrepreneurship to provide sustainable solutions to meet the growing challenges and societal needs.**
4. **To foster collaborative learning and to play adaptive leadership role in professional career and pursuit of higher education through effective mentoring and counselling.**

Core Values

- **Integrity**
- **Leadership**
- **Diversity**
- **Community**

2. Programme Educational Objectives (PEO)

The Educational Objectives of PG Program in Civil Engineering are:

PEO 1. Graduates will be able to develop into proficient resources in the advanced aspects of engineering & technology with analytical and quantitative reasoning and design abilities.

PEO 2. Graduates will be capable of applying the skills to formulate, analyse and solve the societal problems of sustainable development related to their specialization along with maintaining the professional integrity and ethics.

PEO 3. Graduates will be able to grow personally and professionally in the careers through continued development of analytical, technical and managerial skills.

PEO 4. Graduates will excel as entrepreneurs through continuous enhancement of communication skills, professional networking and life-long learning.

PEO 5. Graduates will be prepared to assume higher roles and responsibilities at national and international level to imprint their presence for the larger good of the society.

3. Program Outcomes (PO's)

PO1: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using advanced understanding of mathematics and engineering.

PO2: **Design/development/execution of solutions**: Design sustainable solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public safety, and the cultural, societal, legal and environmental considerations.

PO3: **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.

PO4: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO5: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO6: **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.

PO7: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work effectively, as a member and leader in a multidisciplinary and/or diverse team, to manage projects and in multidisciplinary environments.

PO8: **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PO9: **Leadership in research and practice**: Use a combination of technical, managerial and soft skills to play the leadership role in research and practice.

PO10: **Engineer and Society**: Apply reasoning informed by the appropriate knowledge to asses societal, safety, legal issues and the consequent responsibilities relevant to engineering practice.

PSO1: Design, develop, construct and manage new civil engineering infrastructure.

PSO2: Analyze Evaluate, and Execute sustainable solutions to the structural problems faced by the society.

PSO3: Cognizance of social awareness, environmental necessity, modern management and construction techniques to have a successful career in their respective specializations.

Department of Civil Engineering M.TECH in Civil Engineering 2020-22														
Course Structure for batches admitted in session 2020-21 and onwards														
Semester	**Courses**							**Courses**	**Labs**	**L**	**T**	**P**	**Weekly contact**	**Credits**
I	Advanced Mathematics (3-0-0) 3	Elective 1 (3-0-0) 3	Elective 2 (3-0-4) 5	Elective 3 (3-1-0) 4	Elective 4 (3-0-0) 3	Green Building Methodology (3-0-0) 3		6	1	18	1	4	23	21
II	Environment Health & Safety (3-0-0) 3	Elective 5 (3-1-0) 4	Elective 6 (3-1-2) 5	Elective 7 (3-0-2) 4	Community Connect (0-0-4) 2	Research Methodology (0-0-4) 2	Elective 8 (3-0-0) 3	7	4	15	2	12	29	23
III	Seminar (0-0-4) 2	Dissertation -1 (0-0-20) 10						2	2	0	0	24	24	12
IV	Dissertation -II (0-0-32) 16							0	1	0	0	32	32	16
TOTAL CREDITS														**72**

	Structural Engg	Environmental Engg	Geotechnical Engg	Construction Mgmt
Elective 1	Structural Dynamics	Environmental Chemistry and Biotechnology	Geoenvironmental engineering	Quality Control and Safety Practices in Construction
Elective 2	Advanced Structural Analysis	Solid, Biomedical & Hazardous Waste Management	Soil Foundation Interaction	Project Planning and Management
Elective 3	Advanced Design of Steel Structures	Water and Waste Water Treatment	Dynamics of Soil	Analysis of Construction Cost and Finances
Elective 4	Advance RCC Design	Renewable Energy Technologies	Site Investigation and Improvement Techniques	Contract Laws and regulation
Elective 5	RCC Bridge Design / Damage Assessment Repair and Retrofitting of Structures	Contaminant Fate & Transport in Environment	Geotechnical Earthquake Engineering	Quantitative Methods in Construction Management
Elective 6	Theory of Elasticity and Plasticity	Remote Sensing and GIS	Advance Foundation Engineering	Estimation and Quantity Surveying
Elective 7	Advance Concrete Technology	Management of Industrial Effluents	FEM in Geotechnical Engineering	Advance Concrete Technology
Elective 8	Earthquake Resistant Design of Structures	Air Pollution Control	Reinforced Soil Structure	Construction Equipment Management

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School of Engineering & Technology

Batch: 2020-22

Program / Branch: M.Tech STR/ENV/CM/GTE **Semester: I**

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits	Core/Elective Pre-Requisite/ Co Requisite	Type of Course[1]: 1. CC 2. AECC 3. SEC 4. DSE
				L	T	P			
THEORY SUBJECTS									
1	16269	CVL834	ADVANCED MATHEMATICS	3	0	0	3	MATHS 1 & 2	CC
2			**ELECTIVE-1**	3	0	0	3	-	DSE
	15238	CVL702	Structural Dynamics					Maths and Physics	
	15242	CVL665	Environmental Chemistry and Biotechnology					-	
	16173	CVL831	Geoenvironmental Engineering					-	
	15794	CVL826	Quality Control and Safety Practices in Construction					-	
3			**ELECTIVE-2**	3	0	0	3	-	DSE
	15239	CVL703	Advanced Structural Analysis					Structural	

[1] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

								Analysis I & II	
	15027	CVL642	Solid, Biomedical & Hazardous Waste Management					-	
	15452	CVL728	Soil Foundation Interaction					-	
	16270	CVL836	Project Planning and Scheduling					-	
4			**ELECTIVE-3**	3	1	0	4	-	DSE
	15240	CVL704	Advanced Design of Steel Structures					Design of Steel Structures	
	15028	CVL643	Water and Waste Water Treatment					-	
	15538	CVL744	Dynamics of Soil					-	
	15796	CVL829	Analysis of Construction Cost and Finances					-	
5			ELECTIVE-4	3	0	0	3	-	DSE
	15791	CVL823	Advance RCC Design					Design of Concrete Structures	
	15243	CVL666	Renewable Energy Technologies					-	
	004641	CVL727	Site Investigation and Improvement Techniques					-	
	15795	CVL827	Contract Laws and regulation					-	
6	15793	CVL825	GREEN BUILDING METHODOLOGY	3	0	0	3	-	CC
PRACTICAL									
7			ELECTIVE LAB 1	0	0	4	2	-	SEC
	15351	CVP656	COMPUTER AIDED SAD					-	
	15541	CVP658	ADVANCE GEOTECHNICAL ENGINEERING LAB					-	
	15031	CVP654	ENVIRONMENTAL ENGINEERING					-	

			LAB						
	15716	CVP852	CONSTRUCTION MANGEMENT LAB-1					-	
TOTAL							21		

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Batch: 2020-22

Program / Branch: M.Tech STR/ENV/CM/GTE **Semester: II**

S. No.	Paper ID	Subject Code	Course	Teaching Load			Credits	Core/Elective Pre-Requisite/ Co Requisite	Type of Course2: 1. CC 2. AECC 3. SEC 4. DSE
				L	T	P			
THEORY SUBJECTS									
1	005690	CVL676	ENVIRONMENT HEALTH AND SAFETY	3	0	0	3	-	CC
2			**ELECTIVE-5**	3	1	0	4	-	DSE
	16363	CVL833 / CVL838	RCC Bridge Design / Damage Assessment Repair & Retrofitting of Structures					Design of Concrete Structures	
	004028	CVL667	Contaminant Fate & Transport in Environment					-	
	004966	CVL730	Geotechnical Earthquake Engineering					-	
	005826	CVL806	Quantitative Methods in Construction Management					-	
3			**ELECTIVE-6**	3	1	0	4	-	DSE
	002777	CVL622	Theory of Elasticity and Plasticity					Strength of Materials	

[2] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

	005688	CVL645	Application of Remote Sensing and GIS for Environmental Planning					-	
	004968	CVL729	Advance Foundation Engineering					-	
	005396	CVL804	Estimation and Quantity Surveying					-	
4			**ELECTIVE-7**	3	0	0	3	-	DSE
	006661	CVL715	Advance Concrete Technology					Concrete Technology	
	16367	CVL832	FEM in Geotechnical Engineering					-	
	004029	CVL668	Management of Industrial Effluents					-	
	006661	CVL715	Advance Concrete Technology					-	
5			**ELECTIVE-8**	3	0	0	3		DSE
	004963	CVL708	Earthquake Resistant Design of Structures					Structural Analysis I & II	
	15029	CVL644	Air Pollution Control					-	
	004969	CVL731	Reinforced Soil Structure					-	
	006664	CVL828	Construction Equipment Management					-	
PRACTICAL									
1			ELECTIVE LAB 2	0	0	2	1	-	SEC
	002781	CVP652	STRUCTURAL ENGINEERING LAB					-	
	004975	CVP733	APPLICATION OF FEM IN GEOTECH					-	
	006665	CVP853	CONSTRUCTION MANAGEMENT LAB-II					-	
	002927	CVP655	ENVIRONMENTAL MODELLING LAB					-	
2			ELECTIVE LAB 3	0	0	2	1	-	SEC

	005689	CVP645	Application of Remote Sensing and GIS for Environmental Planning Lab					-	
			STRUCTURE DESIGN LAB					-	
	002781	CVP652	STRUCTURAL ENGINEERING LAB					-	
3	16119	CCU101	COMMUNITY CONNECT	0	0	4	2	-	SEC
4	16396	MRM001	RESEARCH METHODOLOGY	0	0	4	2	-	SEC
TOTAL CREDITS							**23**	**-**	

SHARDA UNIVERSITY

School of Engineering & Technology

Batch: Batch: 2020-22

Program / Branch: M.Tech STR/ENV/CM/GTE **Semester: III**

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits	Type of Course[3]: 1. CC 2. AECC 3. SEC 4. DSE
				L	T	P		
PRACTICAL SUBJECTS								
1	15247	CVL681	SEMINAR	0	0	4	2	AECC
2	15249	CVL691	DISSERTATION-1	0	0	20	10	AECC
						TOTAL	**12**	

[3] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

SHARDA UNIVERSITY

School of Engineering & Technology

Batch: 2020-22

Program / Branch: M.Tech STR/ENV/CM/GTE **Semester: IV**

S. No.	Paper ID	Subject Code	Subjects	Teaching Load			Credits	Type of Course[4]: 1. CC 2. AECC 3. SEC 4. DSE
				L	T	P		
PRACTICAL SUBJECTS								
1	15249	CVL 692	DISSERTATION PART-2	0	0	32	16	AECC
						TOTAL	**16**	

[4] CC: Core Course, AECC: Ability Enhancement Compulsory Courses, SEC: Skill Enhancement Courses, DSE: Discipline Specific Courses

STRUCTURAL ENGINEERING

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (STRUC. ENGG)		**Semester: I**	
1	Course Code	CVL834	Course Name: ADVANCED MATHEMATICS
2	Course Title	ADVANCED MATHEMATICS	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Core	
5	Course Objective	This course will provide students an understanding and ability to use certain concepts of mathematics which are useful for their courses. The emphasis is on matrices, statistics, numerical methods and distribution.	
6	Course Outcomes	CO1: To revise basic concepts of Matrices and Determinants and Linear Equations. CO2: To understand the various statistical methods applicable in engineering. CO3: To identify the use of Finite Difference and Finite Element scheme in engineering. CO4: To understand the concepts of calculus of variation. CO5: To understand the application of probability theory in engineering. CO6:To apply the concepts of basic mathematics in engineering real world problems	
7	Course Description	Linear Algebra, Statistical Methods, Introduction to Numerical Methods, Calculus of Variation, Probability.	
8	Outline syllabus		
	Unit 1	**Linear Algebra**	
	A	Properties of Matrices and Determinants	
	B	Linear Equations and their representations in matrix form, Eigen Values and Eigen Vectors	
	C	Matrix Transformation and Inverse	
	Unit 2	**Statistical Methods**	
	A	Measures of Central Tendency, Dispersion	
	B	Skewness and Kurtosis – Principles of least squares	
	C	Correlation and regression	
	Unit 3	**Introduction to Numerical Methods**	

	A	Introduction to Finite Difference Scheme		
	B	Introduction to Finite Element Scheme		
	C	Unequal interval problems.		
	Unit 4	**Calculus of Variation**		
	A	Concept of maxima and minima of functions		
	B	Constraints and Lagrange's multipliers		
	C	Euler's equation and their solution.		
	Unit 5	**Probability Theory**		
	A	Terminology, Laws of Probability		
	B	Binomial Distribution, Poisson's Distribution		
	C	Normal Distribution		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Advanced Engineering Mathematics by E. Kreyszig, John Wiley & Sons, 2010, ISBN: 0470458364		
	Other References	1. Advanced Engineering Mathematics by Alan Jeffrey, Academic Press, 2001. ISBN: 0080522963.		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: I**	
1	Course Code	CVL702	Course Name: STRUCTURAL DYNAMICS
2	Course Title	STRUCTURAL DYNAMICS	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective 1	
5	Course Objective	The objective of this course is to provide students an understanding and ability to learn fundamentals of structural dynamics, techniques used for solving dynamic problems and real life dynamic problems.	
6	Course Outcomes	CO1: Free vibrations of single degree of freedom system-Damped and undamped, natural frequency problems, CO2 Formulation and solution of Single Degree of Freedom Systems, Free, Forced, Damped and Undamped vibration response CO3: Formulation of MDOF-Undamped Free Vibrations, Problems for natural frequencies and mode shapes, or thogonality of modes CO4: Free and Forced Vibration of Continuous Systems CO5: Effect of Soil Structure Interaction on structural response CO6:Apply the fundamentals of structural dynamics, techniques used for solving dynamic problems and real life dynamic problems	
7	Course Description	This course will be helpful in understanding the dynamic behavior of structures. For the structural engineers it is very important to know the dynamic behavior of structures and the effect of Soil Structure Interaction on structural response	
8	Outline syllabus		
	Unit 1	**Theory of Vibrations**	
	A	Introduction-Elements of Vibratory system, Degrees of freedom, continuous system	
	B	Lumped Mass idealization, Oscillatory Motion, Simple Harmonic Motion	
	C	Free Vibrations of Single degree of freedom system- Damped and Un-damped Vibrations	
	Unit 2	**Introduction to Structural Dynamics**	
	A	Objective of Dynamic Analysis, Types of prescribed loading, Formulation of Equation of Motion-D'Alembert's Principle	
	B	Formulation and solution of Single Degree of Freedom Systems	

	C	Free, Forced, Damped and Undamped vibration response		
	Unit 3	**Multi Degree of Freedom Systems**		
	A	Selection of degree of freedom, evaluation of structural property matrices, Formulation of MDOF-Undamped Free Vibrations		
	B	Solution for Eigen Value Problem for natural frequencies and mode shapes		
	C	Orthogonality of modes, Mode Superposition Principle.		
	Unit 4	**Free and Forced Vibration of Continuous Systems**		
	A	Introduction, Flexural Vibrations in Beams		
	B	Derivation of governing differential equation of motion		
	C	Analysis of undamped free vibrations of beams in flexure		
	Unit 5	**Introduction to Soil Structure Interaction**		
	A	Objectives of SSI		
	B	Effect of Soil Structure Interaction on structural response		
	C	Kinematic and inertial interactions		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. A. K. Chopra, "Dynamics of Structures," PHI 2. Clough and Penzien, "Dynamics of Structures," CSI 3. S. R. Damodarasamy and S. Kavitha, "Structural Dynamics and Aseismic Design," PHI		
	Other References	1. Seismic analysis of structures by T.K.datta, John wiley and sons Pvt Ltd, 2010 2. Theory of Vibration with Application; W.T. Thomson; Prentice Hall 3. Mario Paz, "Structural Dynamics: Theory & Computation," CBS Publishers And Distributors		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: I**	
1	Course Code	CVL 703	Course Name: ADVANCED STRUCTURAL ANALYSIS
2	Course Title	ADVANCED STRUCTURAL ANALYSIS	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective 2	
5	Course Objective	This course will provide students an understanding and ability to use Force and Displacement Method for analysis of structure. Through which students can find out the behaviour of structure subjected to various loading which will be useful for Designing.	
6	Course Outcomes	CO1: Distinguish between analysis of Determinate and Indeterminate Structures. CO2: Design stiffness and flexibility matrix by using global and element approach CO3: Analyze beam and frame by Stiffness and Flexibility Method CO4: Identify the effect of temperature, lack of fit and to understand Element Approach CO5:Analyze the beam curved in plan. CO6: understand the to use Force and Displacement Method for analysis of structure.	
7	Course Description	Review of basic structural analysis i.e. Virtual work method, Maxwell-Betti's theorem, conjugate beam etc. Analysis of continuous beam, frame and trusses by using stiffness and Flexibility methods. Element approach and substructure analysis. Analysis of beam curved in plan.	
8	Outline syllabus		
	Unit 1	**Review of basic structural analysis**	
	A	Review of Work and Energy Principles, Maxwell-Betti's and Castiglano's Theorem,	
	B	Principle of Virtual Work	
	C	Degrees of Freedom, Static and Kinematic Indeterminacy.	
	Unit 2	**Stiffness and Flexibility Matrix**	
	A	Direct Stiffness Approach, Stiffness Matrix Assembly, Incorporation of Boundary Element Solutions	
	B	Gauss Elimination, Matrix Inversion	
	C	Truss Element, Beam Element, Element Flexibility Matrix	
	Unit 3	**Stiffness Method**	
	A	continuous beams (settlement of Supports)	

	B	Rigid jointed frames, Substructure analysis		
	C	Analysis of Pin Jointed Frames (temperature effect, lack of fit),		
	Unit 4	**Flexibility Method**		
	A	Force Transformation Matrix		
	B	Continuous Beams (with and without settlement of supports)		
	C	Analysis of Rigid Jointed frames		
	Unit 5	**Beams Curved in Plan**		
	A	Forces developed at a section of curved beam, Torsion factor		
	B	analysis of beam curved in plan		
	C	Semi-circular beam fixed at two end subjected to concentrated load and UDL		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Reddy C.S., Basic Structural Analysis, Tata McGraw Hill Publishing Company, New Delhi. 2. Gupta and Pandit, Structural Analysis: A Matrix Approach, TMH. 3. Structural Analysis II by S SBhavikatti		
	Other References	1. Analysis of Indeterminate Structures – C.K. Wang, Tata McGraw-Hill, 1992 2. Theory of Structures by S. Ramamrutham 3. Weaver & Gere “Matrix Structural Analysis,” CBS Publisher		

School: SET		**Batch : 2020-22**
Program: M.TECH		**Current Academic Year: 2020-21**
Branch: CE (STRUC. ENGG)		**Semester: I**
1	Course No.	CVL704
2	Course Title	ADVANCED DESIGN OF STEEL STRUCTURE
3	Credits	4
4	Contact Hours (L-T-P)	(3-1-0) Elective 3
5	Course Objective	Structural Steel is one of the commonly used materials for construction of high rise buildings, bridges and other structures. This course is about studying properties of steel, behaviour of structural steel elements, and design procedures for these elements to withstand structural loads according to IS 875 and IS 800-2007. Objective of this course to get knowledge of design of beam-column, plastic design of indeterminate structure, Design of plate girder and role of steel as prestress member. Students will able to design complex structure member.
6	Course Outcomes	CO1: Describe the key material and section properties of structural steels; explain how these properties affect structural performance, and how construction and operational factors may influence structural performance, brittle and fatigue failure. CO2: Examine the different types of beam-column members, analysis the effect of bending on beam-column and design according to Indian Standards(IS 800) CO3: Discuss the need of Plastic analysis for indeterminate structure and to design economical section. CO4: Explain the roof truss and illustrate the different kinds of load act on it. Also, demonstrate its design procedure. CO5: Use of steel as Prestress main member and property of steel for high stresses. CO6: Able to design complex structure member.
7	**Outline syllabus:**	
Unit A		**Introduction of steel structure**
A		Structural steels.
B		Brittle fracture.
C		Fatigue.

Unit B		**Stability of beam columns, frames**
A		Introduction of Beam-Column.
B		Modes of Failures.
C		Design Specification as per IS 800.
Unit C		**Plastic design of steel structures**
A		Basic Assumptions, Shape Factors, Load Factors, Moment Redistribution, Static and Kinematic theorems.
B		Analysis of Single Bay and Two Bay Portal Frames, Methods of Plastic Moment Redistribution.
C		Effect of Axial Force and Shear Force on Plastic Moment.
Unit D		**Plate girders**
A		Design of Sections.
B		Bearing and Intermediate Stiffeners, connections.
C		Flange and Web Splices.
Unit E		**Prestressed steel construction and Introduction of Gantry girder.**
A		Introduction to Steel Property for prestress
B		Role of steel in prestress.
C		Introduction of gantry girder.
8	Course Evaluation	
8.1	Course work: 30 marks	
8.11	Attendance	None
8.12	Homework	05 assignments, 2 Assignment considered; 10 marks
8.13	Quizzes	4 best quizzes (based on assignments) in tutorial hours; 20 marks
8.14	Projects	None
8.15	Presentations	None
8.16	Any other	
8.2	MTE	One, 20 marks
8.3	End-term examination: 50 marks	
9	References	
9.1	Text book	N. Subramanian, “Design of Steel Structures”, Oxford University Press.

9.2	Other references	1. IS: 875 – 1987 "Code of Practice for Design Loads" (Parts I to V). 2. IS: 800 – 2007 "Use of Structural Steel in General Building Constructions", BIS. 3. Steel Table by BIS 4. S SBhaviKatti, Design of Steel Structures (By Limit State Method as Per IS: 800 2007)I K International Publishing House, 2009. 5. Charles G. Salmon, John E. Johnson, FarisA.Malhass, "Steel Structures: Design and Behaviour," Prentice Hall.

School: SET		**Batch : 2020-22**	
Program: M.Tech.		**Current Academic Year: 2020-21**	
Branch: CE		**Semester: I**	
1	Course Code	CVL823	Course Name: ADVANCED R.C.C. DESIGN
2	Course Title	ADVANCED R.C.C. DESIGN	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE 4	
5	Course Objective	The objective of this Course is to provide knowledge with more advanced coverage of various topics relating to the design of concrete structures. The course will enhance the knowledge of various design methods and behaviour of material in different conditions.	
6	Course Outcomes	CO1: Understand the design of flat slabs and identify the difference between normal slabs and flat slabs. CO2: Understand the design of various types of foundations required for a building. CO3: To understand the design of various storage structures like Water Tanks. CO4: Learn the design of various types of retaining walls like cantilever retaining walls. CO5: Understand the design of special structural elements like deep beams, shear walls and long columns. CO6:Design complex RCC structure	
7	Course Description	Foundation, Retaining Walls, Water Tank and Domes Design, Long Column Design, Deep Beam and Shear Wall Design	
8	Outline syllabus		
	Unit 1	**Design of Flat Slab**	
	A	Behavior Analysis, Stresses in Slabs	
	B	Reinforcement Requirement	
	C	Design of Flat Slabs	
	Unit 2	**Design of Foundations**	
	A	Design of Strip Foundation	
	B	Design of Raft Foundation	
	C	Design of Pile foundation and Pile Cap	

	Unit 3	**Water Tank**		
	A	Design of Intz Tanks		
	B	Design of Circular Tanks resting on ground		
	C	Design of Domes		
	Unit 4	**Design of Retaining Walls**		
	A	Analysis of cantilever retaining wall		
	B	Design of Heel and Toe slab		
	C	Design of Vertical stem		
	Unit 5	**Special Structural Elements**		
	A	Design of Shear Walls		
	B	Design of Deep Beams		
	C	Design of Long Columns		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. N. Krishna Raju, "Advanced Reinforced Concrete Design", CBS Publishers & Distributors. 2. S.S. Bhavikatti, "Advance RCC Design", New Age International.		
	Other References	1. Indian standard on "PLAIN AND REINFORCED CONCRETE -CODE OF PRACTICE," Bureau of Indian Standard, 2000 – IS456:2000 2. A.K Jain, "Reinforced concrete limit state design" by Nem Chand & Bros, Roorkee 3. S. Pillai and Devdas Menon, "Reinforced concrete structure", Tata McGraw Hill Education Pvt. Ltd. 4. P.C. Varghese, "Advanced Reinforced Concrete Design", PHI Learning Private Limited. 5. S.N. Sinha, "Reinforced Concrete Design", Tata McGraw Hill Education Pvt. Ltd.		

School: SET		**Batch: 2020-22**	
Program: M. TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: I**	
1	Course Code	**CVL 825**	Course Name:
2	Course Title	**Green Building Methodology**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Core	
5	Course Objective	To provide students an understanding of the various aspects of Green buildings and their certification process.	
6	Course Outcomes	CO1: Understand the necessity of green buildings and their basic requirements, CO2: Have knowledge of various components of a green building, CO3: Understand comprehensively the LEED certification criteria, CO4: Have comprehensive knowledge of GRIHA certification criteria, and CO5: Have the knowledge of various renewable energy systems for green buildings. CO6: Have understanding of the various aspects of Green buildings and their certification process.	
7	Course Description	This course teaches the Green buildings requirements and their certification process.	
8	Outline syllabus		
	Unit 1	**Introduction**	
	A	Need & importance of Green buildings	
	B	Basic requirements of a green building	
	C	Rating systems	
	Unit 2	**Components of Green Buildings**	
	A	Sustainable site, Building materials	
	B	Heating & cooling systems, energy efficiency	
	C	Water management, indoor environmental quality	

	Unit 3	**Rating systems: LEED**		
	A	Certification criteria		
	B	Certification process		
	C	LEED AP requirements & certification process		
	Unit 4	**Rating systems: GRIHA**		
	A	Certification criteria		
	B	Certification process		
	C	GRIHA accredited professional- requirements & certification process		
	Unit 5	**Renewable energy systems for Green Buildings**		
	A	Need of renewable energy, Solar cells		
	B	Grid-connected and off-grid systems, solar heaters		
	C	Components of a solar panel based electrical system		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	Notes by the instructor		
	Other References	1. LEED v4.0 Manuals available online 2. GRIHA Manuals available online 3. IGBC Manuals available online		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE		**Semester: II**	
1	Course Code	CVL676	Course Name: Environmental health and Safety
2	Course Title	Environmental health and Safety	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Compulsory	
5	Course Objective	This course is aimed at master's students of Environmental Engg to understand basic principles of environmental health and safety practices and creating awareness of public and occupational health and safety requirements associated with the environment	
6	Course Outcomes	The Student will be able to-- CO1. Understand the need and benefits of environmental health and safety. CO2. Understand safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations CO3. Understand the principles, benefits and framework for a workplace safety and health program required to develop safety excellence CO4. Understand the techniques of implementation, review and documentation of environmental safety CO5. Understand importance of training and knowledge in environmental health and safety. CO6. Diagnose the cause of occupational hazards and design appropriate control measures to improve the health outcomes	
7	Course Description	The course introduces need of occupational health and hygiene, workplace safety, techniques of environmental safety and its training.	
8	Outline syllabus		
	Unit 1	**Introduction**	
	A	Need for developing Environment, Health and Safety systems in work places	
	B	Status and relationship of Acts, Regulations and Codes of Practice. Role of trade union safety representatives	
	C	International initiatives. Ergonomics and work place.	
	Unit 2	**Occupational Health and Hygiene**	

	A	Definition of the term occupational health and hygiene. Categories of health hazards. Exposure pathways and human responses to hazardous and toxic substances		
	B	Advantages and limitations of environmental monitoring and occupational exposure limits. Hierarchy of control measures for occupational health risks		
	C	Role of personal protective equipment and the selection criteria. Effects on humans, control methods and reduction strategies for noise, radiation and excessive stress		
	Unit 3	**Workplace Safety and Safety Systems**		
	A	Features of the satisfactory design of work premises HVAC, ventilation. Safe installation and use of electrical supplies. Fire safety and first aid provision.		
	B	Significance of human factors in the establishment and effectiveness of safe systems. Safe systems of work for manual handling operations. Control methods to eliminate or reduce the risks arising from the use of work equipment.		
	C	Requirements for the safe use of display screen equipment. Procedures and precautionary measures necessary when handling hazardous substances. Contingency arrangements for events of serious and imminent danger.		
	Unit 4	**Techniques of Environmental Safety**		
	A	Elements of a health and safety policy and methods of its effective implementation and review. Functions and techniques of risk assessment, inspections and audits		
	B	Investigation of accidents- Principles of quality management systems in health and safety management. Relationship between quality manuals, safety policies and written risk assessments		
	C	Records and other documentation required by an organization for health and safety. Industry specific EHS issues.		
	Unit 5	**Education and Training**		
	A	Requirements for and benefits of the provision of information, instruction, training and supervision		
	B	Factors to be considered in the development of effective training programs		
	C	Principles and methods of effective training. Feedback and evaluation mechanism.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%

	Text book/s*	1. Environmental and Health and Safety Management by Nicholas P. Cheremisinoff and Madelyn L. Graffia, William Andrew Inc. NY, 1995 2. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007. 3. Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services 2005

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE		**Semester: II**	
1	Course Code	CVL833	Course Name: R.C.C. BRIDGE DESIGN
2	Course Title	R.C.C. BRIDGE DESIGN	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Elective-5	
5	Course Objective	The objective of this Course is to introduce the basics of R.C.C. Bridge Design. The course will cover the Design of Slab and T beam Bridge in detail when they are subjected to various loads. It will introduce the students with IRC loading.	
6	Course Outcomes	CO1: Describe the basics behind the selection of type of bridge, types of IRC loading. CO2:Study and use of various methods of analysis for RCC Bridges CO3: Design of Slab culvert under the effect of various loading as per IRC. CO4: Design of T beam bridge under the effect of various loading as per IRC. CO5:Detailing of reinforcement in various bridge CO6:Design complex RCC structure	
7	Course Description	Introduction to basics of Bridge Design, Analysis Methods. Slab Bridge, T Beam Bridge, Reinforcement Detailing	
8	Outline syllabus		
	Unit 1	**Introduction to Basics of Bridge Design**	
	A	Site selection, various types of bridges and their suitability	
	B	Loads, forces and IRC Bridge loading	
	C	Permissible stresses	
	Unit 2	**Analysis Methods**	
	A	Working Stress Method	
	B	Courbon's method of load distribution	
	C	Pigeaud's Method	
	Unit 3	**Slab Bridge**	

	A	Components of Reinforced Concrete slab Bridge		
	B	Impact Factors		
	C	Design of R.C.C. Slab Culvert		
	Unit 4	**T Beam Bridge**		
	A	R.C.C. T-Beam Bridge, Components of T-Beam Bridge,		
	B	Types of Superstructure		
	C	Design of T-Beam Bridge.		
	Unit 5	**Reinforcement Detailing**		
	A	Detailing criteria		
	B	Reinforcement Derailing for R.C.C. slab Bridge,		
	C	Reinforcement Derailing for R.C.C. T-Beam Bridges.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Design of Bridges by N.Krishna Raju, Oxford and IBH Publishing Co. Ltd., New Delhi, India. 2. Design of Bridge Structure by T.R. Jagdeesh and M.A. Jayaram, Prentice-Hall of India Pvt. Ltd., New Delhi, India.		
	Other References	1. Concrete Bridge Practice - Analysis, Design and Economics by V.K. Raina, Tata McGraw Hill, New Delhi. 2. **IRC 21 : 2000** Standard specifications and code of practice for road bridges, Section III : Cement concrete (plain and reinforced) (Indian Roads Congress, New Delhi) 3. **IRC 112 : 2011** Code of practice for concrete road bridges (Indian Roads Congress, New Delhi) 4. **IS 456 : 2000** Indian Standard Plain and Reinforced Concrete (Bureau of Indian Standards, New Delhi)		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (STRUC. ENGG)		**Semester: II**	
1	Course Code	CVL622	Course Name: THEORY OF ELASTICITY AND PLASTICITY
2	Course Title	THEORY OF ELASTICITY AND PLASTICITY	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	Elective-6	
5	Course Objective	This course will introduce students to the theoretical fundamentals of theory of elasticity and plasticity. The student will be able to use the principles of the theory of elasticity and plasticity in engineering problems.	
6	Course Outcomes	To demonstrate the ability to analyse the structure under elastic limit CO2: To demonstrate the application of plane stress and plane strain in a given situation. CO3: To impart the knowledge of stress-strain relations for linearly elastic solids, and Torsion. CO4: To apply theory of plasticity to the structures. CO5: To analyse spherical and cylindrical structures for various stress and strains. CO6: To use the principles of the theory of elasticity and plasticity in engineering problems	
7	Course Description	Theory of elasticity, plane stress and strain, inverse and semi-inverse methods, theory of plasticity, spherical and cylindrical tube	
8	Outline syllabus		
	Unit 1	**Theory of Elasticity**	
	A	Stress tensors, equations of equilibrium	
	B	Generalized Hooke's law, boundary conditions	
	C	Compatibility conditions	
	Unit 2	**Plane Stress and Strain**	
	A	Plane stress and strain, relationship, stress functions	
	B	Stress at a point	
	C	Rectangular and polar coordinates, bending of beam loaded at end	
	Unit 3	**Inverse and Semi Inverse Methods**	

	A	Inverse and Semi Inverse		
	B	Torsion of bars		
	C	Membrane analogy		
	Unit 4	**Theory of Plasticity**		
	A	Introduction		
	B	Hydrostatic and Deviatorial Stress		
	C	Octahedral stresses		
	Unit 5	**Analysis of thick spherical and cylindrical tube**		
	A	Analysis of bending of bars of narrow rectangular cross section, formation of plastic hinge		
	B	Spherical shells		
	C	Problems		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. S.P.Timoshenko&J.N.Goodier, "Theory of Elasticity", McGraw Hill-1970.		
	Other References	1. J.Chakraborty"Theory of Plasticity", McGraw Hill Publication		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: II**	
1	Course Code	CVL 715	Course Name: ADVANCE CONCRETE TECHNOLOGY
2	Course Title	ADVANCE CONCRETE TECHNOLOGY	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective 7	
5	Course Objective	The objective of this Course is 1. To understand the behaviour of various admixtures in mortar/concrete and their importance in various applications. 2. To learn the rheological and hardened properties of concrete and factors affecting fresh properties of concrete. 3. To learn various destructive and Non destructive testing methods 4. To understand the electro-chemical process of corrosion of rebar 5. To understand the IS recommendations for design Mix and quality control in construction work.	
6	Course Outcomes	CO1: Students will be able to prepare workable concrete with/without admixtures, and select suitable testing approach for workability CO2: Students will learn the concept of strength, workability and durability of concrete. Able to use various testing methods on materials and/or structures. CO3: Able to prepare Design Mix concrete and apply quality control measures in construction work. CO4: Able to enhance the strength, fire resistance and thermal properties, and low permeability etc. of concrete. CO5: To Design self compacting concrete, light concrete and high performance concrete etc. CO6: Students will understand the effect of various chemicals on the properties of concrete	
7	Course Description	Rheological properties, factor affecting workability of concrete. Function and applications of admixtures. Mechanical properties of concrete, Durability and factors affecting durability of concrete, NDT test. IS recommendation for DESIGN Mix and quality control. Special concrete i.e. FRP, Geo-polymer, light weight, HPC, HDC and Self compacting concrete.	
8	Outline syllabus		
	Unit 1	**Fresh Concrete and Concrete Mix Design**	
	A	Rheological properties, w/c ratio, Workability of concrete, Factors affecting workability of concrete, Workability Test	
	B	Mixing of concrete, Vibration of concrete, Different types of mixers and vibrators, Concreting in hot weather condition	

	C	Basic considerations, Factors affecting Design mix, Design of concrete mixes by IS method, Introduction to various design methods		
	Unit 2	**Hardened Concrete and Non-destructive testing of concrete**		
	A	Mechanical properties of concrete and their testing Compressive strength, Split tensile strength, Flexural strength, Curing of concrete, Factors influencing the strength of concrete,		
	B	Shrinkage and creep of concrete, Permeability and durability of concrete, Fire resistance of concrete, Thermal properties of concrete, Fatigue & Impact strength of concrete, Corrosion, Electro-Chemical Process, measure of protection.		
	C	Rebound hammer test, Penetration resistance test, Pull-out test, Ultrasonic pulse velocity test		
	Unit 3	**Quality Control and Admixtures**		
	A	Flaws in concrete and its remedial measures, Field control for quality of concrete, Factors causing variation in the quality of concrete, Advantages of quality control, Quality management in concrete construction		
	B	Introduction, Functions of admixtures, Classification of admixtures, effect of chemical admixtures on the properties of concrete		
	C	Chemicals for construction and their application		
	Unit 4	**FRP, Industrial waste in concrete, Ferro-cement and RMC**		
	A	Fiber reinforced concrete. Types of fibers, workability, mechanical and physical properties of fiber reinforced concrete.		
	B	Industrial waste materials in concrete, their influence on physical and mechanical properties and durability of concrete, Concrete at high temperature		
	C	Ferro-cement and Polymer concrete, RMC as per IS 4926:2003		
	Unit 5	**Special concrete in terms of density, strength and performance**		
	A	Light weight concrete and Heavy weight concrete, Mix proportion, fresh and Mechanical properties, application.		
	B	High strength concrete, Ultra High strength concrete, methods and applications.		
	C	High performance concrete, Mix proportion, advantage and applications, Self-compacting concrete, Mix proportion, Workability test for SCC, advantage and disadvantage, Application		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Shetty .M.S., " Concrete Technology, Theory and Practice", Revised Edition, S. Chand & company Ltd., New Delhi,2006 2. Neville. A.M. , " Properties of Concrete", 4th Edition Longman		

	Other References	1. Metha P.K and Monteiro. P.J.M, " CONCRETE", Microstructure, Properties and Materials, Third Edition, Tata McGraw- Hill Publishing company Limited, New Delhi, 2006 3. Mindass and Young, " Concrete", Prentice Hall.

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: III**	
1	Course Code	CVL 708	Course Name: EARTHQUAKE RESIST DESIGN OF STRUCTURE
2	Course Title	EARTHQUAKE RESIST DESIGN OF STRUCTURE	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	Elective 8	
5	Course Objective	This course will provide students an understanding and ability to use IS Code provision for earthquake resistant design and various aspects of design.	
6	Course Outcomes	CO1: To understand the earth interior and causes for the earthquake. CO2: To understand the conceptual design. CO3: Analyze and design of earthquake resistant buildings. CO4: Analyse the risk of failure of existing building. CO5: Analyze the ductility role in the buildings. CO6: To measure the performance of existing structure and enhance the performance with proper detailing	
7	Course Description	Access the probability of earthquake in India, design the earthquake resistant structure and concept for the layout. To measure the performance of existing structure and enhance the performance with proper detailing.	
8	Outline syllabus		
	Unit 1	**Seismic Hazard Management**	
	A	Engineering Seismology Introduction, Seismic Hazard, Seismic Tectonics and Seismic Zoning of India.	
	B	Earthquake basics, plate tectonics, faults, consequence of earthquake, Magnitude and Intensity.	
	C	Effect of earthquake on structures and lesson learnt.	
	Unit 2	**Concept of Earthquake Resistant Design**	
	A	Types of Buildings, Causes of damage, Do's and Don'ts for protection of life and property.	
	B	Philosophy and Principle of Earthquake Resistant Design, Limit states. Inertia forces in structure Guidelines for Earthquake Resistant Design,	
	C	Earthquake Resistant Low Strength Masonry Buildings (IS 13828: 1993), Earthquake Resistant Design of Masonry	

		Buildings-Strength and structural properties of masonry.		
	Unit 3	**Analysis and Design for Earthquake Building**		
	A	Earthquake Resistant Design of R.C.C. Buildings, Response of Structures: Effect of deformations in structure,		
	B	Lateral strength, Stiffness, Damping, Ductility ,Floor Diaphragms: Flexible, Rigid, Numerical example for lateral load distribution		
	C	Torsion in Buildings: Causes, Effects, Centre of mass and rigidity, Torsional coupled and uncoupled system, Lateral load distribution, Concept of capacity design, Strong column weak beam, Soft storey, Calculation of base shear and its distribution by using codal provision.		
	Unit 4	**Vulnerability Assessment of Existing Buildings**		
	A	Vulnerability Atlas of India/ States, Assessment and Retrofitting needs , Seismic Evaluation. Visual Inspection & Study of Drawings (Check list), Insitu Testing Vulnerability Assessment of Urban Areas/ Cities.		
	B	Building Typology Studies (Classification of Buildings). Seismic Vulnerability Reduction		
	C	Retrofit in building.		
	Unit 5	**Ductile Detailing of Structures**		
	A	Impact of Ductility, Requirements for ductility.		
	B	Ductile Detailing, Ductile detailing of structures as per 13920:1993 (Beams).		
	C	Ductile detailing of structures as per 13920:1993 (Columns and joints.)		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures,” Prentice Hall of India. IS 1893 (Part 1): 2016, Criteria for Earthquake Resistant Design of Structures. IS 13920:2016, Ductile Detailing of Reinforced Concrete structures subjected to Seismic Forces.		
	Other References	S.K.Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press, Second Edition 2013.		

School: SET		**Batch : 2020-22**
Program: M.TECH		**Current Academic Year: 2020-21**
Branch: CE		**Semester:**
1	Course Code	CVL838 Course Name: DAMAGE ASSESSMENT, REPAIR AND RETROFITTING OF STRUCTURES
2	Course Title	DAMAGE ASSESSMENT, REPAIR AND RETROFITTING OF STRUCTURES
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Status	Core (Option)
5	Course Objective	The objective of the course is to understand the importance of damage assessment of structures and adopt various methods for repair and retrofitting of structures.
6	Course Outcomes	After completion of the course students will be able to: CO1: Determine the need for rehabilitation of structures. CO2: Classify types of damages, sources and effect of damages in the structure. CO3: Assess various evaluation models, need for damage assessment and procedures of damage assessment in structures. CO4: Determine the retrofitting techniques in the structure. CO5: Choose the appropriate method of repair in structures. CO6: Develop the concept of damage assessment, need for repair and retrofitting in structures.
7	Course Description	Introduction, Distress in structures, Damage Assessment and Evaluation Models, Retrofitting of structures, Repair of structures.
8	Outline syllabus	
	Unit 1	**Introduction**
	A	Introduction
	B	Deterioration of structures with aging
	C	Need for rehabilitation
	Unit 2	**Distress in Structures**
	A	Types of Damages
	B	Sources of Damage
	C	Effect of Damages and Case Studies
	Unit 3	**Damage Assessment and Evaluation Models**
	A	Purpose of Assessment, Rapid Assessment, Surface and Structural Cracks

	B	Damage Assessment Procedures		
	C	Destructive, Semi-Destructive and Non-Destructive Methods		
	Unit 4	**Retrofitting of Structures**		
	A	Introduction, Consideration in retrofitting of structures, Source of weakness in RC framed buildings, Structural Damage due to discontinuous load path, Structural Damage due to lack of deformation, Quality of workmanship and material		
	B	Classification of retrofitting techniques, Retrofitting strategies for RC buildings, Global and Local Retrofitting Methods		
	C	Comparative Analysis of methods of retrofitting.		
	Unit 5	**Repair of Structures**		
	A	Grouting, Detailing, Imbalance of Structural Stability, Rust eliminators and polymers coating for rebar during repair, foamed concrete, mortar and dry pack, vacuum concrete		
	B	Gunite and Shot-crete, Epoxy injection, Mortar repair for cracks, shoring and underpinning		
	C	Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and cathodic protection		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Earthquake Resistant Design of Structures by Pankaj Agarwal and Manish Shrikhande, PHI, 2006.		
	Other References	1. Handbook on Repair and Rehabilitation of RCC buildings, Published by CPWD, Delhi, 2002.		

ENVIRONMENTAL ENGINEERING

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Env. Engg.)		**Semester: I**	
1	Course Code	CVL665	Course Name: Environmental Chemistry & Biotechnology
2	Course Title	Environmental Chemistry & Biotechnology	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE	
5	Course Objective	To provide students an understanding of the various aspects of the chemistry and biotechnology of the environmental contamination	
6	Course Outcomes	The Student will be able to-- CO1: understand the necessity of studying chemistry and biotechnology for decontamination of various environmental media CO2: describe the various chemical reactions taking place in water. CO3: compute the rates of reactions. CO4: compute the amounts of cell mass, sludge, oxygen requirements, etc. in biological systems. CO5: discuss the various applications of biotechnology in environmental engineering. CO6: Explain the technologies, tools and techniques in the field of environmental chemistry & biotechnology.	
7	Course Description	The course introduces the understanding of water chemistry, reaction rates, microbial growth & Kinetics and applications of environmental biotechnology.	
8	Outline syllabus		
	Unit 1	**Introduction**	
	A	Environment Media and Contamination	
	B	Sources of contamination of the environment	
	C	Chemistry and biotechnology of the environmental contamination	

	Unit 2	**Water Chemistry**		
	A	Air-water reactions		
	B	Acid-base, complexation, solubility reactions		
	C	Redox, water-solid reactions		
	Unit 3	**Reaction Rates**		
	A	Rate of reaction, order and kinetics		
	B	Energy and energy kinetics		
	C	Rate of water and water-solid reactions		
	Unit 4	**Microbial Growth & Kinetics**		
	A	Microbial growth and energetics		
	B	Energetics modeling		
	C	Growth kinetics		
	Unit 5	**Applications of Environmental Biotechnology**		
	A	In Wastewater treatment		
	B	Bioremediation, vermicomposting, phytoremediation		
	C	Microbial fuel cells & biogas		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Water chemistry by V.L.Snoeyink and D. Jenkins, Wiley, 1980. 2.Environmental Biotechnology: Principles and Applications, Bruce E. Rittmann and Perry L. McCarty, McGraw Hills, 2001		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Env. Engg.)		**Semester: I**	
1	Course Code	CVL642	Course Name: Solid, biomedical and Hazardous Waste Management
2	Course Title	Solid, biomedical and Hazardous Waste Management	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE	
5	Course Objective	This course is designed to provide students with an understanding of technical issues and the management of solid wastes. The course includes solid waste policy, both domestic and international, and then examines appropriate methods of storage, collection, transfer, treatment and disposal appropriate for industrialised and developing countries. The course also provides the opportunity to visit recycling facilities and disposal sites to better understand links between theory and practice	
6	Course Outcomes	The Students will be able to- CO1. To comprehend the implications of the production, resource management and environmental impact of solid waste management. CO2. To explain components of solid waste management infrastructure systems to minimize the above effects. CO3. To design engineered systems for solid waste management including composting and landfills. CO4. To justify the significance of recycling, reuse and reclamation of solid wastes. CO5. To evaluate the characteristics of biomedical waste and suggest measures for its remediation. CO6. To examine appropriate methods of storage, collection, transfer, treatment and disposal of solid waste	
7	Course Description	The course introduces the concepts of waste management, including the sources, characteristics and measures needed for the remediation.	
8	Outline syllabus		
	Unit 1	**Introduction to solid waste**	
	A	Sources, Composition & Properties of solid waste	
	B	Handling & Separation of solid waste	
	C	Municipal Waste (Management & Handling Rules, 2000), Hazardous Waste (Management & Handling Rules, 1989 and	

		amendments), Federal Hazardous Waste Regulations under RCRA, Superfund, CERCLA & SARA and Life cycle analysis of waste.		
	Unit 2	**Engineered Systems for Solid waste management-I**		
	A	Integrated solid waste management (SWM) System, Hierarchical approach for SWM. Solid Waste Collection & Transportation		
	B	Methods of Disposal of Solid Waste		
	C	Landfills: Classification, Types & methods, Site selection, Site preparation, Composition, Characteristics, Generation, & Control of Landfill gases; Composition, Formation, Movement & control of leachate in landfills; landfill design.		
	Unit 3	**Engineered Systems for Solid waste management-II**		
	A	Re-vegetation of closed landfill sites, Long term post closure plan, Groundwater monitoring during & after closure. Hazardous Waste Landfill remediation.		
	B	Composting: Theory of composting, Manual and mechanized composting, Design of composting plan		
	C	Recovery of bio-energy from organic waste.		
	Unit 4	**Systems for resources and Energy Recovery**		
	A	Thermal Conversion Technologies: Incineration, Pyrolysis & Gasification Systems. Types & design of Incinerators.		
	B	Treatment methods of Hazardous waste management: Air Stripping, Carbon Adsorption, Steam stripping neutralization,		
	C	Oxidation- Reduction, Precipitation, Solidification and stabilization, Bioremediation.		
	Unit 5	**Bio medical waste management**		
	A	Characterization of biomedical waste & Storage of biomedical waste, Segregation of biomedical waste; Bio-medical wastes (Management & Handling) Rules, 1998, Amendments & guidelines		
	B	Techniques of Biomedical waste management: Autoclaving, Microwave radiations, Chemical treatments.		
	C	Introduction to linear programming & transportation problem, Route & cost optimization.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, “Environmental Engineering”, McGraw-Hill-International Editions. 2. Bala Krishnamoorthy, “Environmental Management, Text Book and Cases”, PHI Publication.		
	Other	1. George Tchobanoglous, Hilary Theisen, Samuel A. Viquel, “Integrated Solid Waste Management: Engineering,		

	References	Principles & Management issues", McGraw-Hill- International Editions. 2. CPHEEO Manual on Municipal Solid Waste Management. 3. Michael D. LaGrea, Phillip L. Buckingham, Jeffrey C. Evans, "Hazardous Waste Management and Environmental Resource Management", McGraw-Hill- International Edition. 4. Mackenzige L. Davis, David A. Cornwell, Introduction to environmental engineering", McGraw-Hill-International Edition. 5. William P. Cunningham, Mary Ann Cunningham, "Principles of Environmental Science", TMH. India. 6. Richard T. Wright, "Environmental Science", Pearson Education.

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Env. Engg.)		**Semester: I**	
1	Course Code	CVL643	Course Name: Water & Wastewater Treatment
2	Course Title	Water & Wastewater Treatment	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	ELECTIVE	
5	Course Objective	To provide students an understanding of the various aspects of the water and wastewater treatment, including source characterization, water/wastewater characterization, etc.	
6	Course Outcomes	The Student will be able to-- CO1: understand the necessity of treating water & wastewater CO2: choose source of water supply, decide on the level of treatment by comparing the raw water quality and quality standards CO3:design the various unit operations in a conventional water treatment plant and understand the operation of domestic water purifiers CO4: use microbial principles & BOD kinetics to characterize the sewage CO5:design the various unit operations needed for sewage treatment CO6: Formulate a preliminary design of a water and/or wastewater treatment plant.	
7	Course Description	The course introduces drinking water characteristics, parameters, waste water characteristics, treatment processes and disposal techniques	
8	Outline syllabus		
	Unit 1	**Introduction**	
	A	Necessity of Water Treatment	
	B	Necessity of Wastewater Treatment	

	C	Introduction to water & wastewater treatment		
	Unit 2	**Drinking Water**		
	A	Water source selection		
	B	Water quality parameters		
	C	Drinking water standards		
	Unit 3	**Water Treatment**		
	A	Conventional water treatment processes		
	B	Miscellaneous processes		
	C	Domestic water purification		
	Unit 4	**Wastewater**		
	A	Wastewater sources and characteristics		
	B	Composition & microbiology of wastewater		
	C	BOD Kinetics, Effluent discharge standards		
	Unit 5	**Wastewater Treatment**		
	A	Primary Treatment		
	B	Secondary Treatment		
	C	Tertiary treatment, sludge disposal		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Garg Santosh Kumar, Water Supply Engineering, Khanna Publishers 2. S.K.Garg: Sewage Disposal and Air Pollution Engineering (Environmental Engineering Vol. – II), Khanna Publishers 3. Peavy, H.S., Rowe, D.R. and Tchobanoglous , G "Introduction to Environmental Engineering" McGraw Hill. 1986 4. MetCalf& Eddy Inc: Wastewater Engineering, Tata McGraw Hills 5. CPHEEO, "Manual on sewerage and sewage Treatment", Bureau of Indian Standards, CPHEEO. 1999		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Env. Engg.)		**Semester: I**	
1	Course Code	CVL666	Course Name: Renewable Energy Technology
2	Course Title	Renewable Energy Technology	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE	
5	Course Objective	The course provides an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application.	
6	Course Outcomes	The Student will be able to-- CO1. Understand global energy crisis and need of renewable source of energy in global platform. CO2. Evaluate Challenges in renewable energy sectors CO3. Discuss and design various solar energy technologies along with their challenges. CO4. Describe and design various wind energy technologies along with their challenges. CO5. Understand importance of various other miscellaneous energy technologies. CO6. Examine the various energy field and an emphasis on alternate energy sources and their technology and application	
7	Course Description	This course includes solar energy, wind energy and miscellaneous energy technologies along with their practical use and design.	
8	Outline syllabus		
	Unit 1	**Introduction**	
	A	Global energy crisis	
	B	Types of renewable energy, historical developments in renewable energy	
	C	Challenges and global outlook	
	Unit 2	**Solar Energy Technology**	

	A	Solar cells, generations of solar cells, characterization techniques,		
	B	Materials, degradation and safety		
	C	Fabrication and deployment of photovoltaics,		
	Unit 3	**Solar Energy Technology and Introduction to Wind Energy Technology**		
	A	Design of photovoltaic using “Polysun” software		
	B	Design of solar thermal systems using “Polysun” software		
	C	Challenges and global outlook of solar energy		
	Unit 4	**Wind Energy Technology**		
	A	Basics of wind energy, Components of wind mill		
	B	Design of wind turbines, costing and scaling		
	C	Off-shore wind energy development, challenges and global outlook of wind energy		
	Unit 5	**Miscellaneous Energy Technologies**		
		Geothermal, tidal		
		Hydroelectric, fuel cells (hydrogen and microbial)		
		Biomass energy		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	References	1. A guide to Photovoltaic system Design and installation, California Energy Commission, 2001. 2. Podcast Notes by Instructor 3. MOOCs on “Solar Energy” (edX) and “Organic Photovoltaics” (Coursera). 4. From Penn State Univ, (https://itunes.apple.com/us/itunes-u/design-solar-energy-conversion/id430672321?mt=10) 5. “Solar Energy, basics, technology and systems”, Arno Smets, Delft University. (available with instructor) 6. Wind turbine design cost and scaling model, NREL, US, 2006. 7. "Multi Rotor Wind Turbine Design And Cost Scaling" (2013), Preeti Verma. Masters Theses, MIT.		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Env. Engg.)		**Semester: II**	
1	Course Code	CVL667	Course Name: Contaminant Fate and Transport in Environment
2	Course Title	**Contaminant Fate and Transport in Environment**	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	ELECTIVE	
5	Course Objective	To provide students an in depth understanding on how contaminants move through sub-surface and surface water and how its movement can be mathematically represented through various models.	
6	Course Outcomes	The student will be able to- CO1. Understand general contaminant types and subsurface characteristics. CO2. Understand fundamentals of subsurface flow and transport mechanisms. CO3. Understand the fate of contaminants in subsurface environments. CO4. Understand the fate and transport of contaminants in rivers using different models. CO5. Understand management and restoration of contaminants by various case studies. CO6. Examine on how contaminants move through sub-surface and surface water how its movement can be mathematically represented through various models.	
7	Course Description	The course introduces general contamination and subsurface characterization, fate and transport of contaminant in subsurface water, management and restoration.	
8	Outline syllabus		
	Unit 1	**Introduction to General Contamination and Subsurface Characterization**	
	A	Introduction: Contamination types, fate and transport (point and nonpoint)	
	B	Subsurface I: Characteristics of porous media and aquifer properties (saturated case only). Subsurface II: Iso/Anisotropy and homo/heterogeneity and groundwater flow characterization	

	C	Subsurface III: Well Dynamics		
	Unit 2	**Fate and Transport of Contaminant in Subsurface Water**		
	A	Role of 1D advection in contaminant transport. Role of 1D dispersion and diffusion in contaminant transport		
	B	Introduction to transport and reaction. 1D Advection-Dispersion-Reaction Equation (Reaction limited to linear sorption		
	C	Capture zone design, capture size, and isochrones		
	Unit 3	**Fate and Transport of Contaminant in Surface Water (Focus River)**		
	A	River types and their contamination potential		
	B	Models (1D and First Order only): spills, dissolved oxygen (Streeter-Phelps model), nutrients and pathogens		
	C	Contaminant Loads: Total maximum daily loads (load-duration curve and its application), long-term contaminant loads		
	Unit 4	**Management and Restoration**		
	A	Subsurface water contamination: Pump-and Treat System (introductory),		
	B	Bioremediation, and Natural Attenuation		
	C	Surface water contamination MR: Non-structural Techniques and Structural Techniques		
	Unit 5	Case studies:		
	A	Emerging contaminants, River restoration, Surface Water-Groundwater interaction		
	B	Numerical modeling of fate and transport, Metal/Nonmetal contamination of river/groundwater		
	C	Agriculture related contamination, fate and transport modeling approaches etc		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Natural Attenuation of Fuels and Chlorinated Solvents in the Subsurface by Wiedemeier, et al., Wiley, ISBN: 9780471197492. 2. Water-quality engineering in natural systems by David Chin, John Wiley & Sons, ISBN: 9781118078600. 3. Surface water quality Modelling by Chapra, S., Waveland Press, ISBN: 9781478608301		

School: SET		**Batch : 2020-22**
Program: M.TECH		**Current Academic Year: 2020-21**
Branch: CE (Env. Engg.)		**Semester: II**
1	Course Code	CVL645 Course Name: Application of Remote Sensing and GIS for Environmental Planning
2	Course Title	Application of Remote Sensing and GIS for Environmental Planning
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Status	Elective
5	Course Objective	This course is aimed at master's students of Environmental Engg to understand the usage of geo-informatics tool for env planning and other applications.
6	Course Outcomes	The student will be able to-- CO1: Understand the fundamentals of geo-informatics CO2: Understand the basics of maps and their components CO3: Understand the concepts of Remote sensing CO4: Understand the basics of aerial photogrammetry CO5: Understand the data collection process and management of data CO6:Apply GIs software tool for env planning and other applications
7	Course Description	The course introduces Remote sensing and Image Interpretation, Advance remote sensing, GIS and Cartography, Application of RS and GIS.
8	Outline syllabus	
	Unit 1	**Introduction**
	A	Introduction to Geo-Informatics
	B	GIS system definition, terminology & data types, Map projection, Co-ordinate system, Scale and other map basics
	C	Basic components of GIS software, data models
	Unit 2	**Remote Sensing and Image Interpretation**
	A	Introduction to Aerial and space borne platforms, Remote Sensing: Introduction, concepts & physical basis, Electromagnetic spectrum, radiation laws, atmospheric effects, image characteristics, Sources of remote sensing information, spectral quantities spectral signatures and resolutions

	B	Characteristics spectral reflectance curves for rocks, soil, vegetation and water. Different satellites, type, resolution and usage. Salient features of some of operating Remote Sensing satellite		
	C	Global positioning system (GPS), Introduction to Aerial Photography and photogrammetry, Analog, analytical and digital photogrammetry, height and plan metric		
	Unit 3	**Advanced Remote Sensing**		
	A	Advanced Remote Sensing techniques: Optical, thermal and microwave sensors & their resolutions		
	B	Digital image processing, Introduction, Image rectification and Restoration		
	C	Image enhancement, Manipulation, Image classification, Fusion.		
	Unit 4	**GIS and Cartography**		
	A	GIS Data acquisition, both raster based and vector based data input and data processing and management including topology, overlaying		
	B	Integration and final data product and report generation. Principle of cartography and cartographic design. Map Layout		
	C	Introduction to Geo Statistics		
	Unit 5	**Application of RS and GIS**		
	A	Application of Geo-spatial technology in Environmental Management, Assessment of cyclones, rainfall, atmospheric humidity etc.		
	B	Application of RS in weather analysis, forecasting and modelling		
	C	Applications in Land use, inventory and monitoring, forestry, urban planning, snow and glaciers, coastal zone management, pollution-land, air, and water, sustainable development, climate change		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Reference books			

School: SET		**Batch: 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Env. Engg.)		**Semester: II**	
1	Course Code	CVL668	Course Name: Management of Industrial Effluents
2	Course Title	Management of Industrial Effluents	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE	
5	Course Objective	The aim of the course is to provide an understanding of the mechanisms and processes used to treat waters that have been contaminated in some way by anthropogenic industrial or commercial activities prior to its release into the environment or its re-use. To understand various terms used in industrial wastewater treatment and to acquaint with different steps involved in treatment of industrial wastewater.	
6	Course Outcomes	The Student will be able to-- CO1. Understand the need and standards for disposal of industrial waste. CO2. Understand the characterization of various waste generated from industries CO3. Understand the various physical chemical and biological techniques for treatment of waste water. CO4. Understand the characteristics of effluent generated from different industries and suggest treatment technologies based of type of waste. CO5. Understand the economic feasibility of suggested effluent treatment techniques along with its management in practical field CO6. To examine various terms used in industrial wastewater treatment and to acquaint with different steps involved in treatment of industrial waste water	
7	Course Description	The course introduces various physical chemical biological treatment of industrial waste water along with planning and management of waste.	
8	Outline syllabus		

	Unit 1	**Introduction**		
	A	Standards for disposal of treated industrial wastewaters into water bodies, municipal sewer and land		
	B	Standards for disposal of industrial solid wastes and gaseous emission from various industries		
	C	Industrial waste generation (solid & liquid waste and gaseous emission) and their characteristics, variation in its quality and quantity, Estimation of capacity of equalization tank		
	Unit 2	**Introduction to Physical-Chemical-Biological techniques for industrial wastewater treatment**		
	A	Equalizations - Neutralization – Oil separation – Flotation – Precipitation – Heavy metal Removal– Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors		
	B	Chemical oxidation – Ozonation – carbon adsorption - Photocatalysis – Wet Air Oxidation – Evaporation		
	C	Ion Exchange – Membrane Technologies – Nutrient removal. - Treatability studies		
	Unit 3	**Industrial Wastewater treatment of industries**		
	A	Manufacturing process, Waste streams (solid, liquid and gaseous)		
	B	Effluent characteristics		
	C	Treatments of effluent from paper/pulp industry, tannery, dairy, sugar mill		
	Unit 4	**Industrial Wastewater treatment of industries**		
		Treatments of effluent from fertilizer plant, thermal power plant and dairy		
		Treatments of effluent from integrated steel plant, distillery/brewery and oil refinery.		
		Treatments of effluent textile unit- cotton, jute, rayon and silk.		
	Unit 5	**Planning and Management**		
	A	Economic feasibility of joint treatment of raw industrial effluent with municipal sewage		
	B	Planning and management of industrial wastes (solid, liquid and gaseous) from small scale industries		
	C	Case studies		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Reference	1. S. P. Mahajan, “Pollution Control in Process Industries”, Tata Mc Graw Hill Publications.		

	books	2. W. Wesley Eckenfelder Jr.," Industrial Water Pollution Control ", Mc Graw Hill Publications. 3. Ronald W. Crites Sherwood C. Reed and Robert Bastion, " Land Treatment Systems for Municipal & Industrial Wastes " Mc Graw Hill Publications. 4. Neal K. Ostler, " Industrial Waste Stream Generation ", Prentice Hall. 5. A.D. Patwardhan, Industrial waste water treatment, PHI

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Env. Engg.)		**Semester: I**	
1	Course Code	CVL644	Course Name: Air Pollution Control
2	Course Title	Air Pollution Control	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	ELECTIVE	
5	Course Objective	This course is designed to provide students an understanding of the various aspects of the air pollution effects, control, including techniques for air quality monitoring and modelling.	
6	Course Outcomes	The Student will be able to-- CO1. Understand classification and effects of air pollution CO2. Implement various legislations and standards related control of air pollution. CO3. Understand techniques of air quality monitoring by various samplers CO4. Describe various plume characteristics, dispersion of air pollutants by various models, analysis of indoor air quality CO5. To evaluate various techniques of emission control & standards for control of air pollutants. CO6. To inspect various aspects of the air pollution effects, control, including techniques for air quality monitoring and modelling	
7	Course Description	The course introduces various effects of air pollution, air quality standards, monitoring techniques, air pollutant dispersion and modelling techniques, prevention & control, vehicular emission control.	
8	Outline syllabus		
	Unit 1	**Air pollution and its Effects**	
	A	Air Pollutants - Sources, Classification, Effect on Health, Vegetation, Materials, and Atmosphere.	

	B	Chemical and Photochemical Reactions in the Atmosphere and their Effects - Smoke, Smog, Acid Rain and Ozone Layer Depletion		
	C	Green House Gases, Global Warming and its Implications		
	Unit 2	**Air Pollution Legislation and Standards**		
	A	The Factories Act and Amendment, 1981 - The Air (Prevention and Control of Pollution) Act		
	B	1982 - The Air (Prevention and Control of Pollution) Rules, 1982 - The Atomic Energy Act		
	C	1987 - The Air (Prevention and Control of Pollution) Amendment Act, 1988 - The Motor Vehicles Act.		
	Unit 3	**Ambient air quality monitoring techniques**		
	A	High-Volume Sampling, Handy Sampler, Bioaerosols sampler		
	B	Indoor Air Sampler, Stack Sampling		
	C	Meteorology and Air Pollution: Atmospheric Stability and Inversions, Behaviour of Air Pollutant Plumes as Affected by Nature of Source, Meteorology, Obstacles and Terrain, Maximum Mixing Depth		
	Unit 4	**Air pollution Dispersion and Modelling**		
	A	Effluent Dispersion Theories - Models for Point and Line Sources Based on Gaussian Plume Dispersion and their Limitations		
	B	Models for Heavy Gas Dispersion. Issues of Indoor Air Quality.		
	C	Control of Air Pollutants - Concepts and the Design Elements of Gravitational Settlers, Centrifugal Collectors, Wet Collectors, Electrostatic Precipitators, Fabric Filters, Condensers		
	Unit 5	**Air pollution Prevention and Control and Vehicular emission control**		
	A	Air Pollution Control by Absorption, Adsorption, Condensation, Incineration, Bioscrubbers, Biofilters, etc and Case Studies.		
	B	Emission standards for automobiles, Origin of exhaust emissions from gasoline, Diesel, CNG & LPG engines, Crankcase and evaporative emissions		
	C	Emission reduction by fuel changes, Emission reduction by engine design changes, Catalytic converters, Diesel engine emissions.		
	Mode of examination	Theory		
	Weightage	CA	MTE	ETE

	Distribution	30%	20%	50%
	Text books	1. Introduction to Environmental Engineering and Science, G. M. Masters, Prentice-Hall of India, New Delhi, 2011. 2. Air Pollution Control Engineering, N. de Nevers. McGraw Hill, Singapore, 2011. Fundamentals of Air pollution, R. W. Boubel, D. L. Fox, and A. C. Stern, Academic Press, NY, 2011. 3. M.N. Rao & H.V.N. Rao, "Air Pollution", Tata McGraw- Hill		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Env. Engg.)		**Semester: II**	
1	Course Code	CVL678	Course Name: Environmental Economics and Management
2	Course Title	Environmental Economics and Management	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE	
5	Course Objective	The aim of the course is to provide students with understanding and confidence with environmental management techniques and to understand their importance	
6	Course Outcomes	CO1: Understand the procedures, tools and techniques for Environmental Impact Assessment (EIA) CO2: Understand the process of planning and performing environmental audit CO3: Understand the environmental management, procedures, tools, techniques and strategies CO4: Understand about various ISO certification related to environmental management along with environmental management practical case studies CO5: Understand and develop clear concepts of environmental design and economics. CO6: Apply environmental management techniques and to understand their importance in relation with real world problems.	
7	Course Description	This course includes EIA, environmental audit, planning &monitoring, EMS, ISO certification and various case studies.	
8	Outline syllabus		
	Unit 1	**Environmental Impact Assessment**	
	A	EIA Origin, Concepts, Methodologies, Screening, Scoping, Base Line Studies, Mitigation, Matrices and Check list	
	B	Types of EIA - Rapid & Comprehensive, Legislative and Environmental Clearance Procedures in India, Prediction Tools for EIA;	
	C	Documentation of EIA, Environmental Management Plan, Post Project Monitoring.	
	Unit 2	**Environmental Audit**	
	A	Guidelines for Environmental Audit (EA), Environmental Auditing Procedure	

	B	Types of EA, Waste Audits and Pollution Prevention Assessments		
	C	EA in Industrial Projects; Liability Audits and Site Assessment; Auditing of EMS.		
	Unit 3	**Environmental Management Systems**		
	A	Elements of LCA – Life Cycle Costing – Understanding the process, its purpose		
	B	evolution and stages, limitations of LCA, procedure for conducting LCA and its applications		
	C	concept of Eco Labelling		
	Unit 4	**ISO Certification**		
	A	Environmental Management – core elements, benefits, certification body assessments of EMS, documentation for EMS		
	B	EMS Standard: ISO 14000 - Need of Certification, ISO Principles; Certification body assessments of EMS; documentation for EMS		
	C	Implementation of ISO 14001; Difference between ISO 9000 & ISO 14000 and OHSAS 18000;		
	Unit 5	**Environmental Design & Environmental Economics**		
	A	Introduction to the concept of Environmental Design – for manufactured products, buildings and developmental planning, concept of Green Building, LEED requirements		
	B	Introduction to the concept of Environmental Economics – basic definitions, demand-supply curve		
	C	classification of costs, concept of Environmental taxes, economics of natural resources.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Reference Books	1. Complete Guide to ISO 14000, R. B. Clements. Simon & Schuster, 2011. 2. Environmental Management: Principles & Practices, Christopher J. Barrow, Routledge, 1999 - Business & Economics 3. Handbook of Environmental Impact Assessment Vol. I and II, J. Petts, Blackwell Science, London, 2010. 4. Canter R.L., Environmental Impact Assessment, Mc Graw Hill International Edition, 1997 5. John G. Rau and David C. Wooten (Ed), Environmental Impact Analysis Handbook, McGraw Hill Book Company. 6. Environmental Impact Assessment by R. K. Jain. 7. W. Kurge: ISO 14001 Certification – Environmental Management System, Prentice Hall, 1995.		

GEOTECHNICAL ENGINEERING

School: SET		**Batch : 2020-22**
Program: M. TECH		**Current Academic Year: 2020-21**
Branch: CE (Geotechnical)		**Semester: I**
1	Course Code	CVL 831
2	Course Title	Geoenvironmental Engineering
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Type	ELECTIVE
5	Course Objective	1. To generate understanding of soil pollution and contaminant transport. 2. To understand the method of solid waste containment and design of disposal site. 3. To understand the technique of polluted site remediation. 4. To gain knowledge of sustainable remediation technique. 5. To understand the method of waste utilization in geotechnical engineering.
6	Course Outcomes	The student will be able to: CO1: Identify the polluted site and understand the contaminant transport. CO2: Design and analyze waste disposal system. CO3: Reduce the concentration pollutant from the polluted site. CO4: Treat the polluted site by environmental sustainable technique. CO5: Utilize the solid waste as geo-material thereby will be able to reduce the waste storage. CO6: Conduct research studies on various geo environmental topic
7	Course Description	
8	Outline syllabus	
	Unit 1	**Soil-Pollutant Interaction and Contaminant Transport**
	A	Introduction to Geo-environmental, production and classification of waste, causes of soil pollution, factors governing soil-pollutant interaction.
	B	Contaminant transport in sub surface, advection, diffusion, dispersion. Governing equations of contaminant transformation, sorption, biodegradation, ion exchange, precipitation.

	C	Pollution of aquifers by mixing of liquid waste – protecting aquifers, Site investigation at polluted sites (Geophysical techniques, Hydrological investigations etc.)		
	Unit 2	**Containment of Solid and Slurry Waste**		
	A	Disposal of solid waste, Environmental impact of waste dump, Waste containment concept.		
	B	Landfills – Shape and Size of landfills, Type of landfills, Impervious barriers for liners and covers, Stability of landfills, Landfill construction and operation, Hydrological consideration in landfills design.		
	C	Slurry transported wastes, Embankment construction, Design aspects, Environmental impact and control, Vertical barriers for containment.		
	Unit 3	**Remediation of Contaminated Soil**		
	A	Rational approach to evaluate and remediate contaminated sites – monitored natural attenuation – exsitu and insitu remediation – solidification, bio–remediation, incineration, soil washing, electro kinetics, soil heating, verification, bio venting – Ground water remediation – pump and treat, air sparging, reactive well.		
	B	Mechanical modification of contaminated site: Introduction, principles of densification, properties of compacted soil and compaction control specifications for quality controls.		
	C	Hydraulic modification of contaminated site: Introduction, objectives, techniques, Dewatering methods, soil and water relationship, Design of Dewatering systems, filtration, drainage and seepage, electro kinetic dewatering and stabilization.		
	Unit 4	**Phytoremediation: Research and Application**		
	A	Case study of site with mixed contamination, Identification of contaminations, Survival and growth of plant, Effect of plant implementation in soil characteristic.		
	B	Study of fate and heavy metal, Effect of compost addition.		
	C	Research methodology- Soil characterization, Test selection, plant selection, soil and plant sample testing.		
	Unit 5	**Geotechnical Reuse of Waste Material**		
	A	Classification of hazardous and non-hazardous waste, Solidification of waste, Utilization of waste for soil improvement.		
	B	Characterization of waste for soil replacement, Engineering property of waste, Waste material in embankment and fills.		
	C	Environmental impact of utilizing waste as geo-materials.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	• Lakshmi N. Reddy, Hilary. I. Inyang, Geo-Environmental Engineering – Principles and Applications, Makcel Dekker.		

		• D. E. Daniel, Geotechnical Practice for Waste Disposal, Chaman & Hall, London.
	Other References	• P. M. Cherry, Solid and Hazardous Waste Management, CBS Publishers and Distributors Pvt. Ltd.

School: SET		**Batch : 2020-22**
Program: M. TECH		**Current Academic Year: 2020-21**
Branch: CE (Geotechnical)		**Semester: I**
1	Course Code	CVL 728
2	Course Title	Soil Foundation Interaction
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Type	ELECTIVE
5	Course Objective	1. To introduce the students to theory and need for SSI in engineering designs. 2. Should be able to apply the effects of interaction between soil and foundation 3. The ability to apply the concepts for solving multi task applications.
6	Course Outcomes	The student will be able to: CO1: Understand various theories involved in soil structure interaction CO2: Understand capabilities of various models used to simulate the interaction CO3: Understand the features of methods of analysis and apply them in real life applications. CO4: Assess the need for SSI in the different design works where it may be needed. CO5: Use the available numerical tools for SSI. CO6: Apply the concepts for solving multi task applications for engineering design
7	Course Description	Introduction to soil-foundation interaction, Model Analysis of Beams, Analysis of Plates, Elastic Analysis of Piles, Laterally loaded pile
8	Outline syllabus	
	Unit 1	**Introduction**
	A	Introduction to soil-foundation interaction problems
	B	Soil behavior, Foundation behavior, Interface
	C	Scope of soil-foundation interaction analysis, Soil response models
	Unit 2	**Model Analysis of Beams**
	A	Beam on Elastic Foundation- Soil Models: Infinite beam
	B	Two-parameters models, Isotropic elastic half space model
	C	Analysis of beams of finite length
	Unit 3	**Analysis of Plates**

	A	Infinite plate, Winkler, Two parameters, Isotropic elastic medium		
	B	Thin and thick plates, Plates on Elastic Continuum		
	C	Thin and thick rafts, Analysis of finite plates		
	Unit 4	**Elastic Analysis of Piles**		
	A	Elastic analysis of single pile		
	B	Theoretical solutions for settlement and load distributions, analysis of pile group		
	C	Interaction analysis, Load distribution in groups with rigid cap.		
	Unit 5	**Laterally loaded pile**		
	A	Rigid pile, Elastic pile, Standard solutions for different end conditions, Pile on elastic continuum		
	B	Subgrade reaction and elastic analysis		
	C	Interaction analysis and pile raft system, Solutions through influence charts		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Hemsley, J.A, Elastic Analysis of Raft Foundations, Thomas Telford, 1998. 2. McCarthy, D.F. Essentials of Soil Mechanics and Foundations, basic geotechnics (6th Edition), Prentice Hall, 2002. 3. Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979. 4. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley, 1980.		
	Other References	1. Scott, R.F. Foundation Analysis, Prentice Hall, 1981. 2. Structure Soil Interaction - State of Art Report, Institution of structural Engineers, 1978.		

School: SET		**Batch : 2020-22**
Program: M. TECH		**Current Academic Year: 2020-21**
Branch: CE (Geotechnical)		**Semester: I**
1	Course Code	CVL 744
2	Course Title	Dynamics of Soils
3	Credits	4
4	Contact Hours (L-T-P)	3-1-0
	Course Type	ELECTIVE
5	Course Objective	1. To familiarize students with the dynamic properties of soil. 2. To create an understanding about the importance of designing machine foundation for reciprocating and impact machines. 3. To gain ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
6	Course Outcomes	The student will be able to: CO1: Understand the basics of vibration, formulation and mathematical equations. CO2: Understanding the effect of vibration on the soil properties. CO3: Understanding about the different laboratory tests for dynamic loading, liquefaction. CO4: Design of pile for dynamic loading: manual design and design using finite element software (Plaxis 2D). CO5: Design of shallow foundation for dynamic loading: manual design and design using finite element software (Plaxis 2D) CO6: Examine dynamic properties of soil.
7	Course Description	Introduction to Vibration, Dynamic Soil Properties, Shear Strength and Liquefaction, Dynamic Analysis of Piles, Dynamic Analysis of Shallow Foundation.
8	Outline syllabus	
	Unit 1	**Introduction to Vibration**
	A	Fundamentals of theory of vibrations-simple harmonic motion
	B	Vibration analysis procedure- Free and forced vibration with and without damping
	C	Formulation of mathematical model of different vibration modes

	Unit 2	**Dynamic Soil Properties**		
	A	Dynamic moduli, Dynamic elastic constants. Poission's Ratio, Damping ratio, Liquefaction parameters, Laboratory techniques		
	B	Factors affecting shear modulus, Elastic modulus and Elastic Constants		
	C	Propagation of seismic waves in soil deposits - Attenuation of stress waves		
	Unit 3	**Shear Strength and Liquefaction**		
	A	Stress – Strain and Strength characteristics of soils under dynamic loads		
	B	Resonance column test, Triaxial tests under dynamic loads		
	C	Liquefaction of soils and factors influencing liquefaction, Dynamic earth pressure, retaining wall problems under dynamic loads		
	Unit 4	**Dynamic Analysis of Piles**		
	A	Analysis of piles under vertical vibrations		
	B	Analysis of piles under translation and rocking, Analysis of piles under torsion		
	C	Design procedure for a pile supporting the machine foundation		
	Unit 5	**Dynamic Analysis of Shallow Foundation**		
	A	Analysis of shallow foundation under vertical vibrations		
	B	Analysis of shallow foundation under translation and rocking, Analysis of piles under torsion		
	C	Design procedure for a block foundation supporting the machine.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Prakash S and Puri, Foundations for Machines: Analysis and design,Wiley, New York, 1988. 2. Braja M. Das, Fundamentals of Soil Dynamics, Elsevier Publishers, New York. 1983. 3. Swami Saran, Soil Dynamics and machine foundations, Galgotia Publishers, New Delhi, 1997.		
	Other References	1. Kramer S. L., Geotechnical Earthquake Engineering – Pearson Education Inc. New Delhi. 2. Bharat Bhushan Prasad – Advanced Soil Dynamics and Earthquake Engineering, PHI Learning Pvt. Limited, New Delhi, 2011.		

School: SET		**Batch : 2020-22**
Program: M. TECH		**Current Academic Year: 2020-21**
Branch: CE (Geotechnical)		**Semester: I**
1	Course Code	CVL 727
2	Course Title	Site Investigation and Improvement Techniques
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Type	ELECTIVE
5	Course Objective	1. To know the geological condition of rock and soil formation. 2. To establish the groundwater levels and determine the properties of water. 3. To select the type and depth of foundation for proposed structure. 4. To determine the bearing capacity of the site. 5. To learn in-situ stresses and its measurement.
6	Course Outcomes	The student will be able to: CO1: To predict and to solve potential foundation problems. CO2: To investigate the safety of existing structures and to suggest the remedial measures. CO3: To estimate the probable maximum and differential settlements. CO4: To observe the soil the soil performance after construction. CO5: Establish procedures for soil improvement to suit design purpose. CO6: Perform complex geological investigation of a site
7	Course Description	Geotechnical Investigation, Methods of Sampling, Borehole Logging and In-situ Tests, Hydraulic Techniques of Ground Improvement, Mechanical Densification of Soil
8	Outline syllabus	
	Unit 1	**Methods of Geotechnical Investigation**
	A	Introduction to Geotechnical Investigation – Accessible exploration - Test pits, Trenches,
	B	Semi-direct methods - Auger boring, Wash boring, Rotary drilling, Percussion drilling - Stabilization of boreholes.
	C	Indirect methods – Geophysical methods - seismic refraction method - electrical resistivity methods – electrical sounding and electrical profiling – Cross hole seismic test.

	Unit 2	**Samplers and Methods of Sampling**		
	A	Sampling – Disturbed and undisturbed soil sampling – representative samples - Methods to minimize sample disturbance		
	B	Types of samplers – split spoon sampler, piston sampler, thin walled sampler etc.		
	C	Preservation and handling of samples – Piston extruder.		
	Unit 3	**Borehole Logging and In-situ Tests**		
	A	Logging of Boreholes-logging methods- Ground water observations – water table fluctuations and effects		
	B	Preparation of soil profiles - Field Tests – SPT, SCPT, DCPT		
	C	Methods and specifications – visual identification tests, vane shear test, Soil exploration Reports		
	Unit 4	**Hydraulic Techniques of Ground Improvement**		
	A	Scope and necessity of ground improvement in Geotechnical engineering- basic concepts and philosophy		
	B	Classification of Ground Modification Techniques – suitability and feasibility, Emerging Trends in ground improvement.		
	C	Drainage - Ground Water lowering by well points deep wells, vacuum and electro-osmotic methods, Stabilization by thermal and freezing techniques		
	Unit 5	**Mechanical Densification of Soil**		
	A	Methods of compaction- Shallow compaction and deep compaction techniques		
	B	In situ densification -Dynamic compaction, Blasting		
	C	Sand piles – Preloading with sand drains – Stone columns- Lime piles.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Purushothama raj P. (1975), Geotechnical Engineering, Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi. 2. Gopal Ranjan and Rao A.S.R. (2000), Basic and Applied Soil Mechanics, New Age International (P) Ltd., New Delhi. 3. Ramanatha Ayyar, T.S., Ramachandran Nair, C.L. and Balakrishnan Nair, N., Comprehensive Reference book on Coir Geotextiles, Centre for development of Coir Technology, 2002.		
	Other References	1. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001. 2. Moseley, M.D., Ground Treatment, Blackie Academic and Professional, 1998.		

1	Course code	**CVL730**
2	Course Title	**Geotechnical Earthquake Engineering**
3	Credits	**4**
4	Contact Hours (L-T-P)	**(3-1-0)**
5	Course Objective	1. To introduce the student to the fundamentals of soil dynamics giving emphasis on the behaviour of soils under seismic and dynamic loading and on the effect of superficial geology on strong-motion. 2. To enable the student to perform an equivalent-linear site response analysis.
6	Course Outcomes	On successful completion of this module students will be able to CO1: Develop basic competence in assessing seismic hazard and in characterizing earthquake actions. CO2: Understand the fundamental principles of wave propagation and apply them in engineering examples. CO3: Understand basic facets of soil behavior under dynamic loading. CO4: Understand the role of soil deposits in modifying the seismic ground motion. CO5: Perform a site response analysis using analytical and numerical approaches. CO6: Evaluate the liquefaction potential using a range of simplified methodologies and understand the principles of mitigation measures.
7	**Prerequisite**	Students should have basic knowledge of soil foundation interaction
8	**Course Contents**	
8.01	Unit A	**Vibration and Measuring Instruments**
8.02	Unit A Topic 1	Theory of vibration - Basic Definition - Governing equation for single degree freedom system - Forced vibrations
8.03	Unit A Topic 2	Rotating mass type excitation - Base excitation - Isolation vibration measuring instruments.
8.04	Unit A Topic 3	Seismology and earthquakes (basic concepts only), Quantification of earthquake, Intensity and magnitudes.
8.05	Unit B	**Ground Motion Parameters**
8.06	Unit B Topic 1	Ground motion parameters, Estimation of Ground motion parameters
8.07	Unit B Topic 2	Waves in unbounded media, waves in a layered body
8.08	Unit B Topic 3	Attenuation of stress waves, Seismic hazard analysis. Evaluation of Dynamic soil properties
8.09	Unit C	**Wave Propagation and Analysis of Site Effects**
8.10	Unit C Topic 1	Wave propagation Analysis - Site Amplification Need for Ground Response Analysis, Method of analysis

8.11	Unit C Topic 2	One Dimensional Analysis, Equipment linear Analysis site effects		
8.12	Unit C Topic 3	Design Ground Motion, Developing Design Ground Motion. Application of software package Shake-2000		
8.13	Unit D	**Design of Foundations**		
8.14	Unit D Topic 1	Earthquake Resistant Design of foundation of buildings, Design considerations, Geotechnical Architectural Structures od		
8.15	Unit D Topic 2	Seismic analysis. Earthquake Response of slopes, Evaluation of slope stability, Pseudostatic Analysis		
8.16	Unit D Topic 3	Newmark's Study of Block Analysis , Dynamic Analysis - Earth pressure due to ground shaking Evaluation,		
8.17	Unit E	**Seismic Design of Footings and Walls**		
8.18	Unit E Topic 1	Seismic Design of Foundations, Retaining Walls & Slopes - Seismic design requirements for foundation,		
8.19	Unit E Topic 2	Seismic bearing capacity, Seismic settlement, Design loads. Seismic slope stability analysis - Internal stability and weakening instability		
8.20	Unit E Topic 3	Seismic design of retaining walls: Dynamic response of retaining walls, Seismic displacement of retaining walls, Seismic design consideration.		
9	**Course Evaluation**			
		Continuous Assessment	Mid-Term Examination	End-Term Examination
9.11	Attendance	Mandatory	Mandatory	75%
9.12	Assignment/MOOC/NPTEL Courses/ Swayam Courses	5	--	--
9.13	Quizzes	15	--	--
9.14	Projects	--	--	--
9.15	Case Study/ Field Study/Presentations	10	--	--
9.16	Exam	--	Yes	Yes
9.17	Total Marks	30	20	50
10	**Reading Content**			
9.1	Text book*	T1: Kramer, S. (1995). Geotechnical Earthquake Engineering, Pearson, New Delhi. T2: Robert W Day. (2007). Geotechnical Earthquake Engineering Handbook, McGraw Hill, NewYork. T3: Ishihara, K.(1996). Soil Behaviour in Earthquake Geotechnics, Oxford Science, NY.		
9.2	other references	R1: Kamalesh Kumar. (2009). Basic Geotechnical Earthquake Engineering, New Age		

1	Course code	CVL729	
2	Course Title	**Advanced Foundation Engineering**	
3	Credits	4	
4	Contact Hours (L-T-P)	(3-1-0)	
5	Course Objective	1.To generate understanding of information needed to design foundations at the state of the art. 2.To gain abilities to evaluate bearing capacity and settlement failure conditions for shallow and deep foundations. 3.To equip students with modern instrumentation for foundation design and correct selection of soil parameters for foundation design. 4.To enable students select the best foundation solutions for different types of Civil Engineering problems.	
6	Course Outcomes	On successful completion of this module students will be able to CO1: Describe the requirements for the successful design of foundation elements. CO2: Design and analyze foundation systems using conventional methods. CO3: Analyze the results of in-situ tests and transform measurements and associated uncertainties into relevant design parameters. CO4: Analyze the bearing capacity of shallow foundations. CO5: Evaluate immediate settlement of shallow and deep foundations. CO6: Design appropriate foundation systems based on ground-investigation data and be able to select correct soil parameters for the designs.	
7	Outline syllabus		
7.01	CVL729.A	Unit A	**Load on Footing**
7.02	CVL729.A1	Unit A Topic 1	Footings with Eccentric or Inclined Loads
7.03	CVL729.A2	Unit A Topic 2	Footings on Layered Soils, on slope and on top of the slopes, on finite layer with a Rigid Base at Shallow Depth
7.04	CVL729.A3	Unit A Topic 3	Vertical stress distribution beneath footings and for loaded areas of various shapes.
7.05	CVL729.B	Unit B	**Settlement of Foundations**
7.06	CVL729.B1	Unit B Topic 1	Immediate, Consolidation & Creep, Stresses and Displacements in Homogeneous, Layered and Anisotropic Soils.
7.07	CVL729.B2	Unit B Topic 2	Consolidation Settlement; One, Two & Three dimension.

7.08	CVL729.B3	Unit B Topic 3	Caissons and well foundations – design aspects of caissons, open caissons, pneumatic caissons, floating caissons, well foundations, monoliths, design and construction aspects of well foundations.
7.09	CVL729.C	Unit C	**Pile Foundations**
7.10	CVL729.C1	Unit C Topic 1	Single Pile: Vertically loaded piles, Static capacity- α, β and λ Methods
7.11	CVL729.C2	Unit C Topic 2	Dynamic formulae; Wave Equation Analyses; Point Bearing Resistance with SPT and CPT Results;
7.12	CVL729.C3	Unit C Topic 3	Negative Skin Friction; Batter Piles; Under Reamed Piles;
7.13	CVL729.D	Unit D	**Dynamic Behaviour of Footing**
7.14	CVL729.D1	Unit D Topic 1	Foundations for gravity structures, Behaviour under dynamic loading
7.15	CVL729.D2	Unit D Topic 2	Pile foundation, Axial capacity, Lateral capacity ,
7.16	CVL729.D3	Unit D Topic 3	Deflections, constructions, anchored foundations. Static and dynamic analysis of platforms and components
7.17	CVL729.E	Unit E	**Footing on Marine Soil**
7.18	CVL729.E1	Unit E Topic 1	Origin, nature and distribution of marine soils, their engineering properties
7.19	CVL729.E2	Unit E Topic 2	Sampling and sample disturbance in-situ testing
7.20	CVL729.E3	Unit E Topic 3	Design criteria. Environmental loading. Wind, wave and current loads after installation. Stability during towing.
8	Course Evaluation		
8.1	Course work: 30 marks		
8.11	Attendance	None	
8.12	Homework	None	
8.13	Quiz:	Two 30-minutes surprise quizzes in lecture hours: 10 marks	
8.14	Labs:	None	
8.14	Projects		
8.15	Presentations	None	
8.16	Any other		

8.2	MTE	One, 20 marks
8.3	End-term examination:	50 Marks
9	References	
9.1	Text book	• Das, B. M. - Principles of Foundation Engineering 5th Edition Nelson Engineering (2004) • Donald P Coduto – Foundation Design Principles and Practices, 2nd edition, Pearson, Indian edition, 2012. Phi Learning (2008) • Bowles, J. E. - Foundation Analysis & Design 5th Edition McGraw-Hill Companies, Inc. (1996) • Poulos, H. G. & Davis, E. H. - Pile Foundation Analysis and Design john wiley & sons inc (1980-08) • Reese, L. C. & Van Impe, W. F. - Single Piles and Pile Groups under Lateral Loading -Taylor & Francis Group (Jan 2000) • Swami saran, Analysis and Design of Substructures, Oxford & IBH Publishing company Private Ltd., Delhi. • H.G.Poulos, Marine Geotechniques, Unwin Hyman, London

School: SET		**Batch : 2020-22**
Program: M. TECH		**Current Academic Year: 2020-21**
Branch: CE (Geotechnical)		**Semester: II**
1	Course Code	CVL 837
2	Course Title	FEM APPLICATION IN GEOTECHNICAL ENGINEERING
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Type	ELECTIVE
5	Course Objective	1.To enable student with fundamentals of Finite element method. 2. To impart the knowledge and skill of analysing physical problems with FE software. 3.To Understand the basic functions of FE based software and its applications in Geotechnical engineering
6	Course Outcomes	The student will be able to: CO1: Select the appropriate element and mesh for FE analysis for given problem. CO2: Evaluate the type of problem and develop the FE-model. CO3: Analyse the results of in-situ tests and transform measurements and associated Estimate the stresses and strain in soil through FE analysis for given physical problem. CO4: Understand in general how finite elements obtain approximate solutions to differential equations CO5: Analyze the data of different structures by FDM & FEM CO6: Apply the basic functions of FE based software and its applications in Geotechnical engineering
7	Course Description	Load on Footing, Settlement of Foundations, Pile Foundations, Dynamic behaviour of footing, Footing on Marine Soil
8	Outline syllabus	
	Unit 1	**Introduction**
	A	Matrix Algebra – Inversion of matrix – solution of large number of simultaneous equations
	B	Concepts of FEM, Steps involved in Finite Element Analysis Procedure, Merits and Demerits.
	C	Principles of Elasticity: Stress equations, Strain-Displacement relationships in matrix form, Plane stress, Plane strain and axi-symmetric bodies of revolution with Axi-symmetric loading.
	Unit 2	**Displacement Based Element**

	A	Element Properties: Concept of an element, various element shapes, Displacement models, Generalized coordinates, Shape functions.		
	B	Convergent and Compatibility requirements, Geometric invariance, Natural coordinate system - area and volume coordinates.		
	C	Generation of Element Stiffness and Nodal Load Matrices.		
	Unit 3	**Isoparametric Formulation**		
	A	Isoparametric Formulation: Concept, Different isoparametric elements for 2D analysis, formulation of 4-noded and 8-noded isoparametric quadrilateral elements, Lagrangian elements, Serendipity elements		
	B	Discretization of a structure, numbering systems, Aspect ratio its effects, Assemblage, Direct Stiffness method.		
	C	Strain laws: Introduction, Bilinear elastic model, K-G model, hyperbolic model, comparison of models and critical state model with numerical examples.		
	Unit 4	**Geotechnical Problem Formulation**		
	A	Techniques of nonlinear analysis, Constitutive modelling for soils, Non- linear soil parameters		
	B	Geotechnical Applications: Seepage analysis: Finite element discretization of seepage equation, computation of velocities and flows, treatment of free surface boundary,		
	C	Analysis of jointed rock mass: Characters and discontinuity of rock, model behaviour of jointed rocks, plane strain analysis		
	Unit 5	**FEM Software Application**		
	A	Pre-processor & Post processing techniques		
	B	Geotechnical Applications: Applications to study of Bearing capacity and Settlement analysis.		
	C	Geotechnical Applications: Applications to study of embankment dams, Sequential construction, excavations, stress distribution around opening.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	• Introduction to the Finite Element Method, C. S. Desai and J. F. Abel. Van Nostrand Reinhold Company. • Finite element analysis in geotechnical engineering Vol 1 and 2, D. M. Potts and L. Zdravkovic, Thomas Telford publishing, London. • Finite element analysis in geotechnical engineering, D. J. Naylor and G. N. Pande.		

	Other References	• Introduction to the Finite Element Method, J. N. Reddy - McGraw-Hill Publishers. • Finite element analysis - Theory and programming, C. S. Krishna Murthy - Tata McGrawHill. • Finite element Methods, O. C. Zienkiewicz - McGraw-Hill Publishers.

School: SET		**Batch : 2020-22**
Program: M. TECH		**Current Academic Year: 2020-21**
Branch: CE (Geotechnical)		**Semester: II**
1	Course Code	CVL 731
2	Course Title	Reinforced Soil Structure
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Type	ELECTIVE
5	Course Objective	1. To introduce the concepts of geosynthetics. 2. Detailed understanding of the history and mechanism of reinforced soil 3. Knowledge of the various types of geosynthetics, their functions and applications. 4. Detailed knowledge about the design of few reinforced soil structures.
6	Course Outcomes	The student will be able to: CO1: Adopt reinforced soil technique against conventional techniques. CO2: Select suitable reinforcement material and type to suit the functional requirements. CO3: Carry out analysis and design of reinforced soil structures. CO4: Provide the basis for confidently making appropriate decisions when designing geosynthetic-reinforced steep slopes and walls. CO5: Understanding of utilization of geosynthetic for soil improvement. CO6: Design reinforced soil structures.
7	Course Description	Introduction to geosynthetic, Geosynthetics and Design Considerations, Geosynthetics in Slope Stabilization and Retaining Walls, Corrosion and Its Measurements, Reinforcement in Pavement and Embankment
8	Outline syllabus	
	Unit 1	**Introduction**
	A	Historical back ground – Introduction to reinforced soil structures, comparison with reinforced cement concrete structures - advantages- recent developments - area of application
	B	Different, types of geosynthetics – Different Materials, properties and testing
	C	Functions of geosynthetics –Reinforcement, separation, filtration, drainage, moisture barrier - mechanism of reinforced soil.

	Unit 2	**Geosynthetics and Design Considerations**		
	A	Materials used properties, laboratory testing and constructional details.		
	B	Functions and design principles of metallic strips, metallic grids, geotextiles.		
	C	Functions and design principles of geogrids, geomembranes and geocomposites,		
	Unit 3	**Geosynthetics in Slope Stabilization and Retaining Walls**		
	A	Analysis, design and construction of reinforced soil retaining walls – Problems		
	B	Construction methods - Concertina method, telescopic method, sliding method		
	C	Various types of facings - Application of geosynthetics for stabilisation of slopes- Introduction to soil nailing.		
	Unit 4	**Corrosion and Its Measurements**		
	A	Measurement of corrosion factors		
	B	resistivity - redox potential, water content, pH		
	C	Electrochemical corrosion, bacterial corrosion.		
	Unit 5	**Reinforcement in Pavement and Embankment**		
	A	Design applications of reinforced soil structures in pavements. Embankments, slopes.		
	B	Case studies of reinforced soil structures, discussion on current literature.		
	C	Design considerations of reinforcements in retaining walls and foundations. **Latest research in foundation on reinforced soil.**		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Koerner, R.H. Designing with geosythetics, Prentice Hall Inc, 1994. 2. Jones, C.J.E.P. Reinforcement and soil structures, Butterworth Publications, 1996. 3. Jewel, R.A. Soil reinforcement with geotextiles, CIRIA, 1996. 4. Ingold, J.S. and Miller, K.S., Geotextiles hand book, Thomas Telford Ltd, 1988		
	Other References	1. Rankilor, P.R., Membranes in ground engineering, John Wiley & Sons, 1985.		

School: SET		**Batch : 2020-22**
Program: M. TECH		**Current Academic Year: 2020-21**
Branch: CE (Geotechnical)		**Semester: I**
1	Course Code	CVL 735
2	Course Title	Foundation on Expansive Soil
3	Credits	3
4	Contact Hours (L-T-P)	3-0-0
	Course Type	ELECTIVE
5	Course Objective	To provide an understanding of the tools necessary to design and construct foundations on expansive soils sites for a variety of soil types and to solve various problems encountered when building on expansive soils.
6	Course Outcomes	The student will be able to: CO1: Understanding about different type of soil and its chemistry. CO2: Understand the various aspects related to the soil design and structural design of foundations and retaining walls. CO3: Gain confidence when dealing with practical situations requiring special foundations. CO4: Achieve capacity to construct foundation on challenging condition. CO5: Understanding of suitable treatment of problematic soil. CO6: Solve various problems encountered when building on expansive soils
7	Course Description	Properties of Expansion Soil and its Effects, Evaluation of Swelling, Drainage and Cushion Techniques, Piling on Expansive Soil, Remedial Techniques
8	Outline syllabus	
	Unit 1	**Properties of Expansion Soil and its Effects**
	A	Origin of expansive soils – Physical properties of expansive soils
	B	Mineralogical composition – Identification of expansive soils
	C	Field conditions that favour swelling – Consequences of swelling.
	Unit 2	**Evaluation of Swelling**
	A	Swelling characteristics, Laboratory tests.
	B	Prediction of swelling characteristics,

	C	Evaluation of heave.		
	Unit 3	**Drainage and Cushion Techniques**		
	A	Horizontal moisture barriers – Vertical moisture barriers		
	B	Surface and subsurface drainage		
	C	Pre-wetting – Soil replacement – Sand cushion techniques – CNS layer technique.		
	Unit 4	**Piling on Expansive Soil**		
	A	Belled piers – Bearing capacity and skin friction –Advantages and disadvantages		
	B	Design of belled piers		
	C	Under reamed piles – Design and construction.		
	Unit 5	**Remedial Techniques**		
	A	Lime stabilization – Mechanisms – Limitations		
	B	Lime injection – Lime columns		
	C	Mixing – Chemical stabilization – Construction.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Terzaghi, K., and Peck, R.B., "Soil Mechanics in Engineering Practice", Asia Publishing House, Bombay. 2. Terzaghi, K., "Theoretical Soil Mechanics, Wiley, New York. 3. Kurian, N.P., "Design of Foundation Systems – Principles and Practices", 2nd Edition, New Delhi, Narosa publishing House. 4. Ranjan, G., and Rao, A.S.R., "Basic and Applied Soil Mechanics", 2nd Edition, New Age International (P) Limited.		
	Other References	1. Das, M.B., "Advanced Soil Mechanics", 2nd Edition, Taylor & Francis, New York. 2. Teng, W.C., 'Foundation Design", Prentice-Hall of India Pvt. Ltd., New Delhi.		

CONSTRUCTION MANAGEMENT

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: I**	
1	Course Code	CVL826	Course Name: QUALITY CONTROL AND SAFETY PRACTICES IN CONSTRUCTION
2	Course Title	QUALITY CONTROL AND SAFETY PRACTICES IN CONSTRUCTION	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE	
5	Course Objective	Quality is one of the very strong pillars for any construction project. We have to meet the client's requirement and specifications. Since construction site is one of the most dangerous and hazardous place to work on, knowledge of safety measures and best safety practices are of foremost importance.	
6	Course Outcomes	CO1: To study the concept of quality planning and assurance (QA/QC). CO2: To study about quality control CO3: To understand and apply management techniques. CO4: To study quality management standards and principles. CO5: To study about safety and safe work behaviour. CO6: Examine the safety measures and best safety practices for construction site	
7	Course Description	This course focuses on the various measures to enhance and manage the quality parameters related to construction project. It also focuses on various safety issues and safe work practices.	
8	Outline syllabus		
	Unit 1	**Quality Concept**	
	A	Introduction to Quality assurance and quality control (QA/QC)	
	B	objectives of QA/QC	
	C	Planning and control of quality during various stages of project.	
	Unit 2	**Quality Control Techniques**	
	A	Quantitative techniques in quality control	

	B	Quality assurance during construction		
	C	Inspection of materials and machinery.		
	Unit 3	**Quality Management**		
	A	Establishing quality assurance system		
	B	Quality Circle		
	C	Quality audit		
	Unit 4	**Quality Management Standards and Principles**		
	A	Quality standards and Quality Management System		
	B	ISO 9004 & ISO 9000		
	C	Various quality management principles by Juran, Crosby and Deming		
	Unit 5	**Safety in Construction**		
	A	Concept of safety and necessity of safe practices in Construction. Factors affecting safety: Physiological, Psychological and Technological		
	B	Safety Indicators, Safety climate at construction site, factors affecting safe climate		
	C	Safe work behaviour, PPEs. Training for safety awareness and implementation.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Abdul RazzakRumane, "Quality Management in Construction Projects", Taylor & Francis, 2010 2. Richard J. Coble, Theo C. Haupt, Jimmie Hinze, "The Management of Construction Safety and Health", Taylor & Francis, 2000		
	Other References	1. Tim Howarth, Paul Watson, "Construction Safety Management", John Wiley & Sons, 2008 2. Phil Hughes, Ed Ferrett, "Introduction to Health and Safety in Construction: The Handbook for Construction Professionals and Students on Nebosh and Other Construction Courses", Edition 3, Publisher Routledge, 2008		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Construction Management)		**Semester: I**	
1	Course Code	**CVL836**	Course Name: **PROJECT PLANNING AND SCHEDULING**
2	Course Title	**PROJECT PLANNING AND SCHEDULING**	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE	
5	Course Objective	Introducing the concept of Project Management. Delivering the knowledge of tools and techniques used for project planning, scheduling and control.	
6	Course Outcomes	CO1: To introduce the concept of project management and general management. CO2: Identify project scope and prepare work breakdown structure. Understand the concept of developing project networks. CO3: Identify the various activities involved in the projects and develop executable scheduling of these activities. CO4: Identify and analyze resource requirements of a project. CO5: Understand the concept of earned value management and project crashing. Use these methods to monitor and control projects CO6:Perform project planning, scheduling and control for Project Management.	
7	Course Description	This course will provide students an understanding and ability in areas of project management and general management. The emphasis is on planning, scheduling and controlling construction projects.	
8	Outline syllabus		
	Unit 1	**General management**	
	A	Project Management introduction, Project Life Cycle	
	B	Management functions, management styles, objectives of management	
	C	Management techniques and use, organization and forms of organization.	
	Unit 2	**Project Management**	
	A	Work Breakdown Structure	
	B	Project Activities, Activities Relationship	

	C	Drawing project network, Estimating Activity Duration.		
	Unit 3	**Project Planning and Scheduling**		
	A	Principles of planning and scheduling		
	B	Techniques of planning and scheduling - CPM		
	C	Techniques of planning and scheduling - PERT		
	Unit 4	**Resource Management**		
	A	Resource definition, resource management		
	B	Resource allocation, resource levelling		
	C	Material and inventory control, ABC Analysis		
	Unit 5	**Project Controls**		
	A	Problems that may arise during construction, schedule updating		
	B	Earned value management		
	C	Network Crashing		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Chitkara. K.K. Construction Project Management: Planning Scheduling and Control Tata McGraw Hill Publishing Company, New Delhi, 1998		
	Other References	1. Construction Project Management: Theory and Practice Hall Ltd., by - Kumar Neeraj Jha 2. Callahan, M. T., Quackenbush, D. G., and Rowings, J. E., Construction Project Scheduling, McGraw-Hill, New York, 1992 3. Moder, J., C. Phillips and E. Davis, Project Management with CPM, PERT and Precedence Diagramming, Van Nostrand Reinhold Company, Third Edition, 1983 4. PMBOK,6th Edition-1		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: I**	
1	Course Code	CVL 829	Course Name: ANALYSIS OF CONSTRUCTION COST AND FINANCES
2	Course Title	ANALYSIS OF CONSTRUCTION COST AND FINANCES	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	ELECTIVE	
5	Course Objective	Providing the fundamental technical knowledge and skills in Mathematics, Applied Science and engineering subjects to recognize and solve problems in the areas of design, execution and maintenance of engineering.	
6	Course Outcomes	CO1: Develop an understanding of the key concepts of engineering economics and time value of money. CO2: Understand cash flows of uniform and non-uniform series of payments. CO3: Comparison of alternatives using various combinations of payments, rate of return, capitalized cost and benefit-cost analysis. CO4: Learn about Depreciation, inflation and taxation in India. CO5: Understand construction accounting and working capital management. CO6: Solve problems in the areas of design, execution and maintenance of engineering	
7	Course Description	This course will provide students an understanding and ability in areas of Engineering Economics and Financial Management in construction.	
8	Outline syllabus		
	Unit 1	**Engineering Economics**	
	A	Time Value of Money, Cash Flow diagrams, Equivalence	
	B	Single payments in Future, Present and uniform series	
	C	Future payments compared to uniform series payments	
	Unit 2	**Non-Uniform Payments**	
	A	Arithmetic gradient	
	B	Geometric gradient	
	C	Analysis of gradient cash flows	

	Unit 3	**Alternative Comparisons**		
	A	Present, future and annual worth of comparisons		
	B	Rate of return, Incremental rate of return		
	C	Break-even comparison, Capitalized cost analysis, Benefit cost analysis		
	Unit 4	**Depreciation, Inflation and Taxes**		
	A	Depreciation		
	B	Inflation		
	C	Taxes		
	Unit 5	**Financial Management**		
	A	Construction Accounting		
	B	Financial Statements and ratios		
	C	Working Capital Management		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	NPTEL notes on "Construction Cost and Finance", provided to all students through LMS.		
	Other References	R1. Blank, L. T. and Tarquin, A. J., "Engineering Economy", Fourth Edition, WCB/Mc GrawHill, 1998. R2. Bose, D. C., "Fundamentals of Financial management", 2nd ed., PHI, New Delhi, 2010 R3. Boyer, C. B. and Merzbach, U. C., "A History of Mathematics", 2nd ed., John Wiley & Sons, New York, 1989. R4. Gould, F. E., "Managing the Construction Process", 2nd ed., Prentice Hall, Upper Saddle River, New Jersey, 2002.		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: I**	
1	Course Code	CVL827	Course Name: CONTRACT LAWS AND REGULATIONS
2	Course Title	CONTRACT LAWS AND REGULATIONS	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE	
5	Course Objective	The subject intends to impart basic knowledge about construction contracts and laws related to construction sector. This would enable students to understand the process of Tendering and practice of Contract Management and Laws and Regulations related to construction projects.	
6	Course Outcomes	CO1: Processes involved in Tendering, negotiating, warding and management of contracts. CO2: Understand and interprets construction contracts CO3: Understand different contract types used in construction CO4: Understand dispute resolution techniques including arbitration, negotiation, mediation and conciliation etc. CO5: Interpret laws related to construction sector CO6: Perform tendering and practice of Contract Management and Laws and Regulations related to construction projects	
7	Course Description	The start of any construction project happens by participating in bid and signing of contract. A lot of agreement and contract happens in projects. Its very much important to understand the laws that govern these contracts and how to resolve disputes in a legal framework. This course deals with various laws and regulations related to agreement and contracts. It also focuses of disputes resolving methods and various labour laws.	
8	Outline syllabus		
	Unit 1	**Agreements and Contracts (6)**	
	A	Indian Contracts Act - Indian contract act 1872	
	B	definition of contract and its applicability	
	C	Elements of Contracts	

	Unit 2	**Contract Types(6)**		
	A	Types of contract		
	B	International contracts		
	C	Condition and specification of contract.		
	Unit 3	**Bidding and Tendering(8)**		
	A	Qualification of bidders- Pre qualification - Bidding - Two Cover System		
	B	Tender documents- Evaluation of Tender from Technical, financial aspects		
	C	Tendering and contractual procedures.		
	Unit 4	**Bidding and Tendering(8)**		
	A	Arbitration and conciliation act 1996		
	B	Violations- appointment of arbitrator		
	C	Power and duties of arbitrator - dispute review board.		
	Unit 5	**Laws and Regulations (8)**		
	A	Labour laws - workmen compensation act		
	B	Minimum wages Act - Child labour Act		
	C	Industrial dispute Act. , RERA Act.		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	1. Keith Collier, "Construction Contracts" Reston Publishing Company, Inc, Reston,Verginia. 2. Patil, B.S., "Building and Engineering Contracts" Mrs. S.B. Patil, Pune. 3. John Murdoch & Will Hughes, Construction Contracts - Law and Management" Spon Press, Taylor & Francis Group		
	Other References	1. Gajerai, G.T., "Law relating to Building and Engineering Contracts in India" Butterworths. 2. Govt of India, Central Public Works Department, "CPWD Works Manual 2003." 3. Govt of India, Central Public Works Department, "Analysis of Rates for Delhi (Vol 1 & 2)." and "Delhi Schedule of Rates." 4. Govt of India, Central Public Works Department, "CPWD 7/8: General Conditions of Contracts." 5. Govt of India, Military Engineer Services, "IAFW 2249: General Conditions of Contracts		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: II**	
1	Course Code	CVL806	Course Name: QUANTITATIVE METHODS IN CONSTRUCTION MANAGEMENT
2	Course Title	QUANTITATIVE METHODS IN CONSTRUCTION MANAGEMENT	
3	Credits	4	
4	Contact Hours (L-T-P)	3-1-0	
	Course Status	ELECTIVE	
5	Course Objective	Providing the fundamental technical knowledge and skills in Probability, , decision science and quantitative techniques for construction management	
6	Course Outcomes	CO1 – Revision of basic concepts of probability and statics CO2 – Develop understanding of the concept of linear programming and its solution by graphical and simplex method CO3 – Develop understanding of the concept of transportation and assignment problem CO4 – Develop understanding of the concept of dynamic programming and queuing theory In construction field CO5 – Develop understanding of the concept of game theory and simulation problem In construction field CO6 – Apply fundamental technical knowledge and skills in Probability, decision science and quantitative techniques for construction management	
7	Course Description	Providing the fundamental technical knowledge and skills in Probability, decision science and quantitative techniques for construction management	
8	Outline syllabus		
	Unit 1	**Introduction and concepts of probability and statistics**	
	A	Probability - Revision	
	B	Statistics in construction-I	
	C	Statistics in construction-I	
	Unit 2	**Linear programming**	
	A	Linear programming	
	B	Graphical method of solving Linear programming	

	C	Simplex method		
	Unit 3			
	A	Transportation		
	B	Assignment problems-I		
	C	Assignment problems-I		
	Unit 4			
	A	Dynamic programming		
	B	Queuing theory		
	C	Examples of queuing theory		
	Unit 5	**Decision, game theory and Simulation**		
	A	Decision theory		
	B	Games theory		
	C	Simulations applied to construction		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	Taha, H.A., Operations Research: An Introduction, 8th Edition, Prentice Hall of India, New Delhi, 2010.		
	Other References	Freund, J.E. and Miller, I.R., Probability and Statistics for Engineers, 5th Edition, Prentice Hall of India, New Delhi, 1994. Gupta, S.C. and Kapur, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 1999.		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: II**	
1	Course Code	CVL804	Course Name: ESTIMATION AND QUANTITY SURVEYING
2	Course Title	ESTIMATION AND QUANTITY SURVEYING	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE	
5	Course Objective	Develop understanding of the basic concepts estimation and develop and ability to carry out quantity estimation and rate analysis of various construction works.	
6	Course Outcomes	CO1 – Develop understanding of the basic concepts and rules of quantity estimation, methods of measurement and units of measurement CO2 – Develop understanding and ability to carry out quantity estimation of building CO3 – Develop understanding and ability to carry out quantity estimation of earthwork and water supply works CO4 – Develop understanding and ability to carry analysis an rates for various construction works CO5 – Develop understanding of the basic concepts of valuation and billing CO6- Perform estimation and rate analysis of various construction works	
7	Course Description	This course teaches the basic concepts estimation and rate analysis of various construction works.	
8	Outline syllabus		
	Unit 1	**Introduction To Estimation**	
	A	General items of work in Building. Standard Units Data for Estimates.	
	B	Types of estimate, Detailed, Revised, supplementary,	
	C	Abstract and Approximate method of estimating. Methods of Building estimates, specification	
	Unit 2	**Estimation Of Buildings**	
	A	Detailed Estimates of foundation work, RCC work.	
	B	Detailed Estimates of Brickwork, stonework, woodwork.	
	C	Reinforcement bar bending and bar requirement schedules.	
	Unit 3	**Earthwork Estimation And Water Supply Works**	

	A	Earthwork for roads,		
	B	Earthwork on hilly roads.		
	C	Earthwork of irrigation channel, Water supply works		
	Unit 4	**Analysis Of Rates**		
	A	Factors affecting analysis of rate, Task or turn out of work		
	B	Analysis of Rates for earthwork, concrete works. D P C. Brickwork, stone masonry, Analysis of Rates for Sanitary & water supply works		
	C	Analysis of Rates for plastering, pointing, road work, carriage of materials.		
	Unit 5	**Valuation And Billing**		
	A	Purpose of Valuation, Principles of valuation,		
	B	Sinking Fund, Depreciation		
	C	Methods of valuation, Billing		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	Dutta B.N. Estimating and Costing, UBS publishers, 2000.		
	Other References	Gurcharan Singh and Jagdish Singh, Estimating costing and valuation, Standard Publishers, 2011 Shah M.H and Kale C.M, Principles of building drawing Tata Mc Graw Hill Publishing co. Ltd., New Delhi.		

School: SET		**Batch : 2020-22**	
Program: M.TECH		**Current Academic Year: 2020-21**	
Branch: CE (Structures)		**Semester: II**	
1	Course Code	CVL828	Course Name: CONSTRUCTION EQUIPMENT MANAGEMENT
2	Course Title	CONSTRUCTION EQUIPMENT MANAGEMENT	
3	Credits	3	
4	Contact Hours (L-T-P)	3-0-0	
	Course Status	ELECTIVE	
5	Course Objective	To develop understanding about modern equipment used in construction. Develop selection and procurement strategies for construction equipment. Plan, manage and maintain modern construction equipment usage at construction site and	
6	Course Outcomes	CO1 – Develop understanding of the modern construction equipment, their planning and selection CO2 – Apply the principles of economics for procurement of construction equipment CO3- Develop understanding about different earth moving equipment used in modern construction CO4- Develop understanding about different earth hoisting and transportation equipment used in modern construction CO5 - Develop understanding about different earth piling and concreting equipment used in modern construction CO6- Examine the selection and procurement of various equipment used in modern construction	
7	Course Description	The course teaches the used, selection and procurement of various equipment used in modern construction.	
8	Outline syllabus		
	Unit 1	**Equipment Management**	
	A	Planning and management of equipment.	
	B	Factors affecting selection of equipment - technical and economic.	
	C	Equipment maintenance management	
	Unit 2	**Equipment Economics**	
	A	Equipment Economics-Equipment costs, Ownership and operating cost	
	B	Buy/Rent/Lease options,	
	C	Replacement analysis.	
	Unit 3	**Earthwork Equipment**	

	A	Analysis of production outputs and costs,		
	B	Characteristics and performances of earthwork equipment.		
	C	Excavators, scraper, dredger		
	Unit 4	**Erection and Transporting**		
	A	Cranes- Mobile Cranes,		
	B	Tower Cranes , launching girder		
	C	Trailer, Dumpers.		
	Unit 5	**Piling Concreting and Tunneling**		
	A	Piles and Piling equipment		
	B	Concrete construction (including batching, mixing, transport, and placement)		
	C	Tunneling		
	Mode of examination	Theory		
	Weightage Distribution	CA	MTE	ETE
		30%	20%	50%
	Text book/s*	Jerry Irvine, Advanced Construction Techniques CA Rockers, 1984 Peurifoy, R.L., Ledbetter, W.B. and Schexnayder.C, Construction Planning Equipment and Methods, McGraw Hill. Singapore 1995		
	Other References	Sharma S.C. Construction Equipment and Management, Khanna Publishers, Delhi, 1988 Deodhar, S.V. Construction Equipment and Job Planning Khanna Publishers Delhi, 1988 Dr. Mahesh Varma, Construction Equipment and its planning and application, Metropolitan Book Company, New Delhi 1983		