9. B.Tech. in Civil Engineering

9. (a) Mission of the Department

Mission Stmt - 1	*To move up through international alliances and collaborative initiatives in civil engineering to achieve global excellence*
Mission Stmt - 2	*To accomplish a process to advance knowledge in a rigorous research environment related to civil engineering and allied disciplines*
Mission Stmt - 3	*To attract and build people in a rewarding and inspiring environment by fostering freedom, empowerment, creativity and innovation.*

9. (b) Program Educational Objectives (PEO)

PEO - 1	*Graduates will pursue higher studies in civil engineering, management and other related fields*
PEO - 2	*Graduates will perform as professional engineers in the fields of civil engineering*
PEO - 3	*Graduates will perform in diverse fields and gradually move into teamwork and leadership positions.*
PEO - 4	*Graduates will contribute to the development of the profession, nation and society*

9. (c) Mission of the Department to Program Educational Objectives (PEO) Mapping

	Mission Stmt. - 1	Mission Stmt. - 2	Mission Stmt. - 3
PEO - 1	*H*	*H*	*M*
PEO - 2	*H*	*M*	*H*
PEO - 3	*H*	*M*	*H*
PEO - 4	*H*	*M*	*H*

H – High Correlation, M – Medium Correlation, L – Low Correlation

9. (d) Mapping Program Educational Objectives (PEO) to Program Learning Outcomes (PLO)

	Program Learning Outcomes (PLO)														
	Graduate Attributes (GA)												Program Specific Outcomes (PSO)		
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
PEO - 1	*H*	*H*	*H*	*H*	*H*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*H*	*H*
PEO - 2	*H*	*H*	*H*	*H*	*H*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*H*	*H*	*H*
PEO - 3	*L*	*L*	*L*	*L*	*M*	*M*	*L*	*H*	*H*	*H*	*H*	*H*	*M*	*M*	*M*
PEO - 4	*L*	*L*	*L*	*L*	*L*	*H*	*H*	*H*	*M*	*M*	*M*	*H*	*M*	*M*	*M*

H – High Correlation, M – Medium Correlation, L – Low Correlation

PSO – Program Specific Outcomes (PSO)

PSO - 1	*Graduates apply the knowledge of mathematical and physical sciences to solve problems in structural engineering, construction engineering management, geotechnical engineering, water resources engineering, environmental engineering and transportation engineering*
PSO - 2	*Graduates are capable of handling and applying modern engineering tools, software, Remote Sensing and GIS for solving civil engineering related problems*
PSO - 3	*Graduates are capable of working in teams in laboratory and industrial environment and carrying out major design projects*

9. (e) Program Structure: B.Tech. in Civil Engineering

Humanities & Social Sciences including Management Courses (H)

Course Code	Course Title	Hours/ Week L	T	P	C
18LEH101J	English	2	0	2	3
18LEH102J	Chinese				
18LEH103J	French				
18LEH104J	German	2	0	2	3
18LEH105J	Japanese				
18LEH106J	Korean				
18PDH101T	General Aptitude	0	0	2	1
18PDH102T	Management Principles for Engineers	2	0	0	2
18PDH103T	Social Engineering	2	0	0	2
18PDH201T	Employability Skills & Practices	0	0	2	1
	Total Learning Credits				**12**

Engineering Science Courses (S)

Course Code	Course Title	Hours/ Week L	T	P	C
18MES101L	Engineering Graphics and Design	1	0	4	3
18MES102J	Basic Civil and Mechanical Engineering	3	1	2	5
18EES102L	Electrical and Electronics Eng. Workshop	1	0	4	3
18CSS101J	Programming for Problem Solving	3	0	4	5
	Total Learning Credits				**16**

Mandatory Courses (M)

Code	Course Title	L	T	P	C
18PDM101L	Professional Skills and Practices	0	0	2	0
18PDM201L	Competencies in Social Skills	0	0	2	0
18PDM203L	Entrepreneurial Skill Development				
18PDM202L	Critical and Creative Thinking Skills	0	0	2	0
18PDM204L	Business Basics for Entrepreneurs				
18PDM301L	Analytical and Logical Thinking Skills	0	0	2	0
19PDM302L	Entrepreneurship Management				
18LEM101T	Constitution of India	1	0	0	0
18LEM102J	Value Education	1	0	1	0
18GNM101L	Physical and Mental Health using Yoga	0	0	2	0
18GNM102L	NSS	0	0	2	0
18GNM103L	NCC				
18GNM104L	NSO				
18LEM109T	Indian Traditional Knowledge	1	0	0	0
18LEM110L	Indian Art Form	0	0	2	0
18CYM101T	Environmental Science	1	0	0	0
18CEM401J	Professional Enhancement Course 1	1	0	2	0
18CEM402J	Professional Enhancement Course 2	1	0	0	0

Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)

Course Code	Course Title	Hours/ Week L	T	P	C
18CEP101L	MOOC - 1	0	0	2	1
18CEP102L	Industrial Training - 1				
18CEP103L	Seminar - 1				
18CEP104L	MOOC - 2	0	0	2	1
18CEP105L	Industrial Training - 2				
18CEP106L	Seminar - 2				
18CEP107L	Minor Project	0	0	6	3
18CEP108L	Internship (4-6 weeks)				
18CEP109L	Project	0	0	20	10
18CEP110L	Semester Internship				
	Total Learning Credits				**15**

Basic Science Courses (B)

Course Code	Course Title	Hours/ Week L	T	P	C
18PYB102J	Physics: Mechanics and Mechanics of Solids	3	1	2	5
18CYB101J	Chemistry	3	1	2	5
18MAB101T	Calculus and Linear Algebra	3	1	0	4
18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
18MAB201T	Transforms and Boundary Value Problems	3	1	0	4
18MAB202T	Numerical Methods for Engineers	3	1	0	4
18MAB301T	Probability and Statistics	3	1	0	4
18BTB101T	Biology	2	0	0	2
	Total Learning Credits				**32**

Professional Core Courses (C)

Course Code	Course Title	Hours/ Week L	T	P	C
18CEC201T	Engineering Geology	3	1	0	4
18CEC202T	Fluid Mechanics	2	1	0	3
18CEC202L	Fluid Mechanics Laboratory	0	0	2	1
18CEC203T	Mechanics of Structures	2	1	0	3
18CEC203L	Strength of Materials Laboratory	0	0	2	1
18CEC204T	Engineering Surveying	2	1	0	3
18CEC204L	Engineering Surveying Laboratory	0	0	2	1
18CEC205T	Structural Analysis	2	1	0	3
18CEC205L	Computer Aided Structural Analysis Laboratory	0	0	2	1
18CEC206T	Hydraulic Engineering and Design	2	1	0	3
18CEC206L	Hydraulic Engineering Laboratory	0	0	2	1
18CEC207T	Design of RC and Steel Structures	4	0	0	4
18CEC208T	Environmental Engineering and Design	2	1	0	3
18CEC208L	Environmental Engineering Laboratory	0	0	2	1
18CEC301T	Hydrology and Water Resources Engineering	3	1	0	4
18CEC302T	Geotechnical Engineering	2	1	0	3
18CEC302L	Geotechnical Engineering Laboratory	0	0	2	1
18CEC303T	Highway Engineering and Design	2	1	0	3
18CEC303L	Highway Engineering Laboratory	0	0	2	1
18CEC304T	Construction Engineering and Management	2	1	0	3
18CEC304L	Construction Engineering and Management Laboratory	0	0	2	1
18CEC305T	Comprehension	0	1	0	1
	Total Learning Credits				**49**

Open Elective Courses (O)
Any 6 Courses

Course Code	Course Title	Hours/ Week L	T	P	C
	Courses offered to Civil Engineering				
18CEO301T	Advanced Design of RCC	2	1	0	3
18CEO302J	Modern Civil Engineering Economics	2	0	2	3
18CEO303J	Modern Tools in Engineering Surveying	2	0	2	3
18CEO304T	Emerging Trends in Steel Design	2	1	0	3
18CEO401T	Advanced Prestressed Concrete Structures	3	0	0	3
18CEO402T	Bridge Engineering	3	0	0	3
18CEO404J	Fundamentals of Computing	2	0	2	3
	Courses offered to other Engineering branches				
18CEO305T	Environmental Impact Assessment	3	0	0	3
18CEO306T	Municipal Solid Waste Management	3	0	0	3
18CEO307T	Disaster Mitigation and Management	3	0	0	3
18CEO405T	Water Pollution and its Management	3	0	0	3
18CEO406T	Global Warming and Climate Change	3	0	0	3
18CEO407T	Applications of Remote Sensing and GIS	3	0	0	3
	Total Learning Credits				**18**

Professional Elective Courses (E) Any 6 Courses					
Course Code	Course Title	Hours/ Week L	T	P	C
	Geotechnical Engineering				
18CEE301T	Foundation Engineering and Design	3	0	0	3
18CEE302T	Geotechnical Design	3	0	0	3
18CEE303T	Ground Improvement Techniques	3	0	0	3
18CEE304T	Foundation on Expansive Soil	3	0	0	3
	Structural Engineering				
18CEE305J	Concrete Technology	2	0	2	3
18CEE306T	Prestressed Concrete Structures	3	0	0	3
18CEE307T	Design of Earthquake Resistant Structures	3	0	0	3
18CEE308T	Design of Steel-Concrete Composite Structures	3	0	0	3
18CEE309T	Geographic Information System	3	0	0	3
	Environmental Engineering				
18CEE310T	Solid and Hazardous Waste Management	3	0	0	3
18CEE311T	Air and Noise Pollution and Control	3	0	0	3
18CEE312T	Environmental Impact Assessment and Life Cycle Analysis	3	0	0	3

Professional Elective Courses (E) Any 6 Courses					
Course Code	Course Title	Hours/ Week L	T	P	C
	Water Resources Engineering				
18CEE313T	Design of hydraulic structures and Irrigation Engineering	3	0	0	3
18CEE314T	Ground Water Engineering	3	0	0	3
18CEE315T	Surface Hydrology	3	0	0	3
	Transportation Engineering				
18CEE401T	Pavement Analysis and Design	3	0	0	3
18CEE402T	Railway, Airport and Harbour Engineering	3	0	0	3
18CEE403T	Traffic Engineering and Management	3	0	0	3
	Construction Engineering and Management				
18CEE404T	Construction Equipment and Automation	3	0	0	3
18CEE405T	Contracts Management	3	0	0	3
18CEE406T	Repair and Rehabilitation of Structures	3	0	0	3
18CEE407T	Sustainable Construction Methods	3	0	0	3
	Total Learning Credits				**18**

9. (f) Program Articulation: B.Tech. in Civil Engineering

Course Code	Course Name	Program Learning Outcomes (PLO)													
		Graduate Attributes											PSO		
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
18CEC201T	Engineering Geology	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M
18CEC202T	Fluid Mechanics	H	H	M	M	M	L	L	L	L	L	L	H	M	M	M
18CEC202L	Fluid Mechanics Laboratory	H	H	M	M	M	L	M	M	L	M	L	H	M	M	L
18CEC203T	Mechanics of Structures	H	M	M	M	M	L	M	L	M	M	L	H	H	H	H
18CEC203L	Strength of Materials Laboratory	H	M	M	M	M	L	M	L	M	M	M	H	H	H	H
18CEC204T	Engineering Surveying	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
18CEC204L	Engineering Surveying Laboratory	H	H	H	H	M	L	L	L	M	L	M	H	L	H	L
18CEC205T	Structural Analysis	H	H	M	H	M	L	M	M	L	L	M	H	M	L	M
18CEC205L	Computer Aided Structural Analysis Laboratory	H	H	H	H	M	L	L	L	M	M	M	M	L	L	L
18CEC206T	Hydraulic Engineering and Design	H	H	H	H	M	L	L	L	H	L	M	H	H	H	L
18CEC206L	Hydraulic Engineering Laboratory	H	H	M	H	M	L	M	M	L	L	M	H	M	L	M
18CEC207T	Design of RC and Steel Structures	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
18CEC208T	Environmental Engineering and Design	H	H	H	H	M	M	M	L	L	L	M	M	L	L	L
18CEC208L	Environmental Engineering Laboratory	H	H	H	H	M	L	M	L	H	L	M	H	M	H	L
18CEC301T	Hydrology and Water Resources Engineering	H	H	M	H	M	L	L	L	M	M	M	H	M	M	L
18CEC302T	Geotechnical Engineering	H	H	M	M	H	H	H	L	M	L	L	H	H	M	M
18CEC302L	Geotechnical Engineering Laboratory	H	H	M	M	M	L	L	L	M	M	M	M	M	M	M
18CEC303T	Highway Engineering and Design	H	H	M	M	M	L	L	L	M	M	H	M	M	M	M
18CEC303L	Highway Engineering Laboratory	H	H	M	H	M	L	L	L	M	M	M	H	M	M	M
18CEC304T	Construction Engineering and Management	H	H	M	H	M	L	L	L	M	M	M	H	M	M	M
18CEC304L	Construction Engineering & Management Lab	H	H	M	H	M	L	L	L	M	M	M	H	M	M	M
18CEC305T	Comprehension	H	H	H	H	M	M	H	M	M	M	H	H	M	M	H
18CEP101L	MOOC - 1	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CEP102L	Industrial Training - 1	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CEP103L	Seminar - 1	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CEP104L	MOOC - 2	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CEP105L	Industrial Training -2	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CEP106L	Seminar - 2	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CEP107L	Minor Project	H	H	H	H	H	M	M	H	H	H	H	H	H	M	M
18CEP108L	Internship (4-6 weeks)	H	H	H	H	H	M	M	H	H	H	H	H	H	M	M
18CEP109L	Project	H	H	H	H	H	M	M	H	H	H	H	H	H	M	M
18CEP110L	Semester Internship	H	H	H	H	H	M	M	H	H	H	H	H	H	M	M
	Program Average	H	H	M	H	M	L	M	L	M	M	M	H	M	M	M

9. (g) Implementation Plan: B.Tech. in Civil Engineering

Semester - I

Code	Course Title	Hours/ Week L	T	P	C
18LEH101J	English	2	0	2	3
18MAB101T	Calculus and Linear Algebra	3	1	0	4
18PYB102J	Physics: Mechanics and Mechanics of Solids	3	1	2	5
18MES101L	Engineering Graphics and Design	1	0	4	3
18MES102J	Basic Civil and Mechanical Engineering	3	1	2	5
18PDM101L	Professional Skills and Practices	0	0	2	0
18LEM101T	Constitution of India	1	0	0	0
18GNM101L	Physical and Mental Health using Yoga	0	0	2	0
	Total Learning Credits				20

Semester - II

Code	Course Title	Hours/ Week L	T	P	C
18LEH10XJ	Chinese / French / German / Japanese/ Korean	2	0	2	3
18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
18CYB101J	Chemistry	3	1	2	5
18EES102L	Electrical and Electronics Eng. Workshop	1	0	4	3
18CSS101J	Programming for Problem Solving	3	0	4	5
18PDH101T	General Aptitude	0	0	2	1
18LEM102J	Value Education	1	0	1	0
18GNM102L	NSS	0	0	2	0
18GNM103L	NCC				
18GNM104L	NSO				
	Total Learning Credits				21

Semester - III

Code	Course Title	Hours/ Week L	T	P	C
18MAB201T	Transforms and Boundary Value Problems	3	1	0	4
18BTB101T	Biology	2	0	0	2
18CEC201T	Engineering Geology	3	1	0	4
18CEC202T	Fluid Mechanics	2	1	0	3
18CEC202L	Fluid Mechanics Laboratory	0	0	2	1
18CEC203T	Mechanics of Structures	2	1	0	3
18CEC203L	Strength of Materials Laboratory	0	0	2	1
18CEC204T	Engineering Surveying	2	1	0	3
18CEC204L	Engineering Surveying Laboratory	0	0	2	1
18PDH102T	Management Principles for Engineers	2	0	0	2
18PDM201L	Competencies in Social Skills	0	0	2	0
18PDM203L	Entrepreneurial Skill Development				
	Total Learning Credits				24

Semester - IV

Code	Course Title	Hours/ Week L	T	P	C
18MAB202T	Numerical Methods for Engineers	3	1	0	4
18CEC205T	Structural Analysis	2	1	0	3
18CEC205L	Computer Aided Structural Analysis Laboratory	0	0	2	1
18CEC206T	Hydraulic Engineering and Design	2	1	0	3
18CEC206L	Hydraulic Engineering Laboratory	0	0	2	1
18CEC207T	Design of RC and Steel Structures	4	0	0	4
18CEC208T	Environmental Engineering and Design	2	1	0	3
18CEC208L	Environmental Engineering Laboratory	0	0	2	1
18PDH103T	Social Engineering	2	0	0	2
18PDM202L	Critical and Creative Thinking Skills	0	0	2	0
18PDM204L	Business Basics for Entrepreneurs				
18CYM101T	Environmental Science	1	0	0	0
	Total Learning Credits				22

Semester - V

Code	Course Title	Hours/ Week L	T	P	C
18MAB301T	Probability and Statistics	3	1	0	4
18CEC301T	Hydrology and Water Resources Engineering	3	1	0	4
18CEC302T	Geotechnical Engineering	2	1	0	3
18CEC302L	Geotechnical Engineering Laboratory	0	0	2	1
	Professional Elective – 1	3	0	0	3
	Professional Elective – 2	3	0	0	3
	Open Elective – 1	3	0	0	3
	Open Elective – 2	3	0	0	3
18CEP101L	MOOC	0	0	2	1
18CEP102L	Industrial Training - 1				
18CEP103L	Seminar - 1				
18PDM301L	Analytical and Logical Thinking Skills	0	0	2	0
19PDM302L	Entrepreneurship Management				
18GNM103T	Indian Traditional Knowledge	1	0	0	0
	Total Learning Credits				25

Semester - VI

Code	Course Title	Hours/ Week L	T	P	C
18CEC303T	Highway Engineering and Design	2	1	0	3
18CEC303L	Highway Engineering Laboratory	0	0	2	1
18CEC304T	Construction Engineering and Management	2	1	0	3
18CEC304L	Construction Engineering and Management Laboratory	0	0	2	1
18CEC305T	Comprehension	0	1	0	1
	Professional Elective – 3	3	0	0	3
	Professional Elective – 4	3	0	0	3
	Open Elective – 3	3	0	0	3
	Open Elective – 4	3	0	0	3
18CEP104L	MOOC - 2	0	0	2	1
18CEP105L	Industrial Training - 2				
18CEP106L	Seminar - 2				
18PDH201T	Employability Skills and Practices	0	0	2	1
18LEM110L	Indian Art Form	0	0	2	0
	Total Learning Credits				23

Semester - VII

Code	Course Title	Hours/ Week L	T	P	C
	Professional Elective – 5	3	0	0	3
	Professional Elective – 6	3	0	0	3
	Open Elective – 5	3	0	0	3
	Open Elective – 6	3	0	0	3
18CEP107L	Minor Project	0	0	6	3
18CEP108L	Internship (4-6 weeks)				
18CEM401J	Professional Enhancement Course 1	1	0	2	0
	Total Learning Credits				15

Semester - VIII

Code	Course Title	Hours/ Week L	T	P	C
18CEP109L	Project	0	0	20	10
18CEP110L	Semester Internship				
18CEM402J	Professional Enhancement Course 2	1	0	0	0
	Total Learning Credits				10

Students are encouraged to undertake courses offered through SWAYAM (Study Web of Active-learning by Young Aspiring Minds) platform to a maximum of 20% of the total credits of the semester. The course(s) on SWAYAM platform that can be adopted as equivalent for transfer to credits of SRMIST

would be informed to the students before start of the semester by the department's MOOC committee based on the guidelines of SRMIST MOOCs committee.

ACADEMIC CURRICULA

Basic Science Courses

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18BTB101T	Course Name	BIOLOGY	Course Category	B	Basic Sciences	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Recall the cell structure and function from its organization			
CLR-2 :	Discuss molecular and biochemical basis of an organism			
CLR-3 :	Compare enzyme reaction and photosynthesis			
CLR-4 :	Explain different types of biosensors			
CLR-5 :	Analyze the different types of bioremediation			
CLR-6 :	Relate the concept of nervous and immune system pertaining to diseases			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Describe the cell growth, metabolism and reproduction.	1	80	80	L	H	H	H	-	M	L	H	H	H	-	H	L	H	H
CLO-2 :	Explain the concepts and experiments in biochemistry	2	85	75	M	H	H	M	-	-	M	H	L	H	-	H	L	H	H
CLO-3 :	Recognize the significance of photosynthesis	2	75	80	M	H	M	H	M	M	-	M	H	H	-	H	L	H	H
CLO-4 :	Discuss the different methods in enzyme catalytic functions	2	85	80	L	H	H	H	-	-	H	L	L	H	-	H	M	H	H
CLO-5 :	Analyze the role of biosensors and its applications	3	85	75	L	H	H	M	-	M	H	H	H	L	-	H	H	H	H
CLO-6 :	Explain the concepts of nervous system disorder and the diseases associated with it	2	80	80	M	H	H	H	L	H	M	M	H	H	-	H	H	H	H

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Basics of cell biology: Relevance to Engineers	Biochemistry: Macromolecules, Biodiversity and its importance	Bioenergetics and metabolism	Molecular machines and motors	Nervous system:History of neuroscience
	SLO-2	Cell basic unit of life, Evidence for cell theory	Chemistry of life	Enzymes as biological catalysts, Significance of enzymes	Properties of ATP based protein molecular machines	Glial cells, Neurons
S-2	SLO-1	Cell structure and function	Biochemistry and human biology, DNA replication	Thermodynamics of enzymes	F0F1 ATP synthase motors, Coupling and coordination of motors	Action potential, Organization of nervous system
	SLO-2	Genetic Information, Protein structure	Transcription, Protein synthesis	Factors affecting enzyme activity, Effect of inhibitors on enzyme activity	Bacterial flagellar motor, Cytoskeleton	Central Nervous system, Peripheral nervous system
S-3	SLO-1	Cell metabolism	Eukaryotic and prokaryotic protein synthesis difference	Mechanism of enzyme action	Microtubules	Diseases of nervous system
	SLO-2	Carbohydrate metabolism, Fatty acid metabolism	Concept of genetic code, Stem cells	Enzyme strategies, Restriction enzymes	Microfilaments, Intermediate filaments	Computer- based neural networks
S-4	SLO-1	Homeostasis	Source of stem cells, Classification of stem cells	NMP kinases, Photosynthesis	Kinesin linear motor, Dynein motor	Immune system
	SLO-2	Pathways that alter homeostasis, Cell growth	Human embryonic stem cell, Importance and applications of stem cells	Light reactions, Photosystems	Biosensor	Fluid systems of the body, Innate immune system
S-5	SLO-1	Reproduction	Therapeutic cloning	ATP synthesis in chloroplasts	Resonant biosensors, Glucose biosensors	Cells of innate immune system, Adaptive immunity

	SLO-2	*Eukaryotic cell division, Mitosis*	*Regenerative medicine*	*Calvin cycle*	*Bio detectors, Biosensor detection in pollutants*	*Diseases of immune system, Immune engineering*
S-6	SLO-1	*Meiosis, Cell differentiation*	*Bone tissue engineering*	*Significance of photosynthesis*	*Bioremediation*	*Cell signaling*
	SLO-2	*Neural crest*	*Gene therapy*	*Metabolism, Glycolysis*	*Bioventing and bio augmentation*	*Cell- surface receptors*

Learning Resources	**1.** *S. Thyagarajan, N.Selvamurugan, R.A.Nazeer et.al., Biology for engineers McGraw Hill Education. 2012*	2. *Norman Lewis, Gabi Nindl Waite, Lee R. Waite et.al., Applied Cell and Molecular Biology for Engineers. McGraw-Hill Education. 2007*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences,ramchand@saksinlife.com	*1. Dr. K Subramaniam, IITM Chennai, subbu.iitm.ac.in*	*Dr. S. Thyagarajan, SRMIST*
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	*2. Dr. R. B. Narayanan, SVCE Chennai, rbn@svce.ac.in*	*Dr.S.Barathi, SRMIST*

Course Code	18BTB103T	Course Name	HUMAN PHYSIOLOGY AND HEALTH	Course Category	B	Basic Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	18BTC102J -Cell biology, 18BTC106J -Immunology
Course Offering Department	Biotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Devise understanding of human physiological systems for a better comprehension of the problems faced by human	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Create an understanding about nervous system that controls and maintains homeostasis			
CLR-3 :	Analyze about circulatory and respiratory system			
CLR-4 :	Analyze about digestive and excretory system			
CLR-5 :	Create an understanding about endocrine and reproductive system			
CLR-6 :	Create an understanding about how human body functions			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Describe the structure and function of cell, communication and gene expression and homeostasis	1	80	70	H	H	H	H	-	M	L	H	H	H	-	H	H	H	H
CLO-2 :	Describe the classification of nervous system, function and diseases associated with it	2	80	70	H	H	H	H	-	H	M	H	H	H	-	H	H	H	H
CLO-3 :	Discuss the structure and function of heart, lung, abnormal functioning	2	80	70	M	H	M	H	M	M		M	H	H	-	H	H	H	H
CLO-4 :	Describe anatomy and function of digestive system and urinary system and its disturbances	2	80	70	H	H	H	H	-	L	H	L	H	H	-	H	H	H	H
CLO-5 :	Describe the types of endocrine system, its role in maintaining homeostasis and reproductive biology	2	80	70	H	H	H	H	-	M	H	H	H	L	-	H	H	H	H
CLO-6 :	Explain how human body function and reproduce with maintaining homeostasis	2	80	70	H	H	H	H	L	M	M	M	H	H	-	H	H	H	H

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Cell structure and function	Classification of Nervous System	Heart: Structure, Chambers, valve	Anatomy of Digestive system	Endocrine organs and structure
	SLO-2	Adaptation, Degeneration and aging	Neuron structure and function	Cardiac cycle and Electro cardio gram	Mouth and Salivary glands	Pituitary gland: Parts
S-2	SLO-1	Cell junctions – Gap, Tight and contact	Nerve fibers classification and properties.	chronotropic, ionotropic agents, dromotropic, bathmotropic agents	Stomach: Parts, Structure, Glands, Functions, Properties	Pituitary gland: Regulation, Histology
	SLO-2	Active, Passive transport	Glial cells types, structure and function	Blood vessels – thromboembolism	composition and functions of gastric juice	Pituitary gland: Hormones secreted, functions
S-3	SLO-1	Types of transport	Synapse – Classification	atherosclerosis and arteriosclerosis	Pancreas, Liver	Thyroid gland: Histology and function
	SLO-2	Special type of transport of molecules across biological membranes	Synapse - Anatomy	Septal and valvular defects.	Gall bladder – Role in digestive system	Thyroid gland: Hormones
S-4	SLO-1	Homeostasis– Chemical equilibrium	Synapse - Functions (IPSP and EPSP	Circulation – Systemic and Pulmonary	Small intestine, large intestine	Synthesis of Thyroxine
	SLO-2	Tonicity and osmolality	Synapse - properties	Properties of cardiac muscle: Excitability – electrical potential and action potential	Digestion of Biomolecules	Parathyroid gland structure and function
S-5	SLO-1	control of homeostasis	Neurotransmitters synthesis	Rhythmicity – Natural and artificial pacemakers	Movements of gastrointestinal tracts and disorders	Mode of action and function - disorders

	SLO-2	*Role of ions in homeostasis*	*Neurotransmitters – Types and function*	*Conductivity, Contractility and Refractory period*	*Digestion of carbohydrates protein and lipid.*	*Adrenal gland structure*
S-6	SLO-1	*Positive feedback regulation of Homeostasis*	*Action potential*	*Cardiac cycle and heart sounds and Heart disease*	*Gastrointestinal hormones*	*Cortical and medullary - functions*
	SLO-2	*Negative feedback regulation of Homeostasis*	*graded potential*	*Respiratory system: Introduction*	*Digestive system disorders*	*Endocrine functions of pancreas*
S-7	SLO-1	*Acid-Base Balance: Hydrogen Ion and pH.*	*Brain anatomy and function*	*Types – external and internal respiration*	*Kidney structure and function*	*Insulin and glucagon*
	SLO-2	*Regulation by buffer systems*	*Spinal cord anatomy– Grey and White matter*	*Inspiration and expiration, Anatomy, functional unit*	*nephron structure*	*Diabetes*
S-8	SLO-1	*Acidosis*	*Limbic system: Autonomic Nervous System*	*Non-respiratory functions of respiratory tract*	*Role of hormone in urinary system.*	*Male reproduction organ structure*
	SLO-2	*Alkalosis.*	*Effects on various organ systems.*	*Mechanics of respiration, Pulmonary function tests: Lung volume – Tidal*	*Juxtaglomerular apparatus functions*	*Female reproduction organ structure*
S-9	SLO-1	*Regulation of gene expression*	*Nervous system disease and disorders*	*Inspiratory, Expiratory, Residual volumes; Lung capacities*	*Process of urine formation*	*Oogenesis*
	SLO-2	*Cell signaling and Signal transduction*	*Parkinson's disease,*	*Inspiratory, vital, Functional residual, Total lung capacities.*	*Factors affecting urine formation*	*Spermatogenesis*

Learning Resources	**1.** *K. Sembulingam, Prema Sembulingam, Essentials of Medical Physiology, Jaypee brothers medical publishers, 7th ed., 2016*	2. *Guyton and Hall, Textbook of Medical Physiology, (Guyton Physiology), Saunders, 13th ed., 2015)*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences, ramchand@saksinlife.com	*1. Dr. K Subramaniam, IITM Chennai, subbu.iitm.ac.in*	*Dr. S. Thyagarajan, SRMIST*
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	*2. Dr. Tamil Selvan, Anna University,Chennai, tamilselvan@annauniv.edu*	*Dr. S. Nageswaran, SRMIST*

Course Code	18MAB201T	Course Name	TRANSFORMS AND BOUNDARY VALUE PROBLEMS	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Describe types of Partial differential equations interpret solutions relate PDE to the respective branches of engineering	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Relate Fourier series expansion in solving problems under RMS value and Harmonic Analysis.			
CLR-3 :	Infer the most general form to the PDE and relate to half range sine and cosine series, as the case may be			
CLR-4 :	Evaluate the various types of integral transforms			
CLR-5 :	Conclude that the purpose of studying z transform is to solve linear difference equations having constant coefficients			
CLR-6 :	Predicting the importance of PDE, Fourier series, Boundary value problems and Fourier ,Z – transform applications			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
CLO-1 :	Determine Partial differential equation	2	85	80
CLO-2 :	Explain the expansion of a discontinuous function as an infinite form of trigonometric sine and cosine series.	2	85	80
CLO-3 :	Decide a proper form of solution for the differential equations which are of hyperbolic and parabolic type	2	85	80
CLO-4 :	justify the relationship between aperiodic signals and linear combination of exponentials.	2	85	80
CLO-5 :	Relate signal analysis with that of z transform	2	85	80
CLO-6 :	Relate PDE, Fourier series, Boundary value problems, Fourier and Z transforms	2	85	80

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Determine Partial differential equation	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-2 :	Explain the expansion of a discontinuous function as an infinite form of trigonometric sine and cosine series.	M	H	-	M	M	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Decide a proper form of solution for the differential equations which are of hyperbolic and parabolic type	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	justify the relationship between aperiodic signals and linear combination of exponentials.	M	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Relate signal analysis with that of z transform	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Relate PDE, Fourier series, Boundary value problems, Fourier and Z transforms	L	L	L	H	H	H	L	H	H	H	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Formation of partial differential equation by eliminating arbitrary constants	Introduction of Fourier series - Dirichlet's conditions for existence of Fourier Series	Classification of second order partial differential equations	Introduction of Fourier Transforms	Introduction of Z-transform
	SLO-2	Formation of partial differential equation by eliminating two or more arbitrary constants	Fourier series –related problems in $(0,2\pi)$	Method of separation of variables	Fourier Transforms- problems	Z-transform-elementary properties
S-2	SLO-1	Formation of partial differential equation by eliminating arbitrary functions	Fourier series –related problems in $(-\pi,\pi)$	One dimensional Wave Equation and its possible solutions	Properties of Fourier transforms	Z-transform- change of scale property, shifting property
	SLO-2	Formation of partial differential equation by eliminating two or more arbitrary functions	Change of interval Fourier series –related problems in $(0,2l)$	One dimensional Wave Equation-initial displacement with zero initial velocity-type 1 Algebraic function	Standard results of Fourier transform	Z-transform of $a^n, \frac{1}{n}, \frac{1}{n+1}$
S-3	SLO-1	Formation of partial differential equation by eliminating arbitrary functions of the form $\phi(u,v)=0$	Fourier series –related problems in $(-l,l)$	One dimensional Wave Equation-initial displacement with zero initial velocity-type 2 Trigonometric function	Fourier Sine Transforms - problems	Z-transform of $\frac{1}{n^2}, \frac{1}{(n+1)^2}$
	SLO-2	Solution of first order non-linear partial differential equations-standard type I F(p,q)=0	Fourier series –half range cosine series related problems$(0,\pi)$	One dimensional Wave Equation-initial displacement with zero initial velocity-type 3 – Midpoint of the string is displaced	Fourier Cosine Transforms - problems	Z-transform of $r^n \cos n\theta$
S-4	SLO-1 SLO-2	Problem solving using tutorial sheet 1	Problem solving using tutorial sheet 4	Problem solving using tutorial sheet 7	Problem solving using tutorial sheet 10	Problem solving using tutorial sheet 13

S-5	SLO-1	*Solution of first order nonlinear partial differential equations-standard type –II Clairaut's form*	*Fourier series –half range cosine series related problems* $(0, l)$	*One dimensional Wave Equation-initial displacement with non-zero initial velocity Type 1 Algebraic function*	*Properties of Fourier sine Transforms*	*Z-transform of* $r^n \sin n\theta$
	SLO-2	*Solution of first order non-linear partial differential equations-standard type III F(z, p, q)=0*	*Fourier series –half range sine series related problems* $(0, \pi)$	*One dimensional Wave Equation-initial displacement with non-zero initial velocity Type 2 Trigonometric function*	*Fourier sine Transforms applications*	*Initial value theorem*
S-6	SLO-1	*Solution of first order non-linear partial differential equations-standard type-IV separation of variable f(x, p) = g(y, q)*	*Fourier series –half range sine series related problems* $(0, l)$	*Wave Equation-initial displacement with non-zero initial velocity Type 3 split function*	*Properties of Fourier cosine Transforms*	*Finial value theorem*
	SLO-2	*Lagrange's linear equation: Method of grouping*	*Parseval's Theorem (without proof)-related problems in Fourier series*	*One dimensional heat equation and its possible solutions*	*Fourier cosine Transforms applications*	*Inverse Z-transform- long division method*
S-7	SLO-1	*Lagrange's linear equation: Method of multipliers*	*Parseval's Theorem (without proof)-related problems in cosine series*	*One dimensional heat equation related problems*	*Convolution of two function*	*Inverse Z-transform, related problems, long division method*
	SLO-2	*More problems in Lagrange's linear equation: Method of multipliers*	*Parseval's Theorem (without proof)-related problems in sine series*	*One dimensional heat equation -Steady state conditions*	*Convolution Theorem*	*Inverse Z-transform, Partial fraction method*
S-8	SLO-1 SLO-2	*Problem solving using tutorial sheet 2*	*Problem solving using tutorial sheet 5*	*Problem solving using tutorial sheet 8*	*Problem solving using tutorial sheet 11*	*Problem solving using tutorial sheet 14*
S-9	SLO-1	*Linear Homogeneous partial differential equations of second and higher order with constant coefficients-CF and PI Type 1:* e^{ax+by}	*Introduction to Harmonic Analysis*	*One dimensional heat equation -Steady state conditions more problems*	*Parseval's Identity for Fourier transform*	*Inverse Z-transform, Partial fraction method related problems*
	SLO-2	*PI Type2.: sin(ax+by) or cos(ax+by)*	*Harmonic Analysis for finding harmonic in* $(0,2\pi)$	*One dimensional heat equation -Steady state conditions with zero velocity*	*Parseval's Identity for Fourier sine & cosine transforms*	*Inverse Z-transform - residue theorem method*
S-10	SLO-1	*Type 3: PI of polynomial*	*Harmonic Analysis for finding harmonic in* $(0,2l)$	*One dimensional heat equation -Steady state conditions with zero velocity more problems*	*Parseval's Identity for Fourier sine & cosine transforms applications*	*Inverse Z-transform - residue theorem method-problems*
	SLO-2	*Type 4 Exponential shifting* $e^{ax+by}f(x,y)$	*Harmonic Analysis for finding harmonic in periodic interval* $(0,T)$	*One dimensional heat equation -Steady state conditions with zero velocity more related problems*	*Fourier Transforms Using Differentiation property*	*Convolution theorem (without proof)*
S-11	SLO-1	*Linear Homogeneous partial differential equations of second and higher order with constant coefficients type 5 General rule*	*Harmonic Analysis for finding cosine series*	*Steady state conditions and Non-zero boundary conditions- related problems*	*Solving integral equation*	*Convolution theorem applications*
	SLO-2	*Applications of Partial differential equations in Engineering*	*Harmonic Analysis for finding sine series*	*Steady state conditions and Non-zero boundary conditions- more problems*	*Self-reciprocal using Fourier Transform, sine and cosine transform*	*Solution of linear difference equations with constant coefficients using Z-transform*
S-12	SLO-1	*Problem solving using tutorial sheet 3*	*Problem solving using tutorial sheet 6*	*Problem solving using tutorial sheet 9*	*Problem solving using tutorial sheet 12*	*Problem solving using tutorial sheet 15*
	SLO-2	*Problem solving using tutorial sheet 3*	*Problem solving using tutorial sheet 6*	*Problem solving using tutorial sheet 9*	*Problem solving using tutorial sheet 12*	*Problem solving using tutorial sheet 15*

Learning Resources	1. *B. H. Erwin kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons,2006* 2. *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2015* 3. *Veerarajan T., Transforms and Partial Differential Equations, Tata McGraw-Hill, New Delhi,2012*	4. *Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 3rd Edition, 2010* 5. *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, for third semester, Laxmi Publications, 3rd Edition, 2014*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	*2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com*	*2. Prof. Ganapathy Subramanian K S, SRMIST*

Course Code	18MAB202T	Course Name	NUMERICAL METHODS FOR ENGINEERS	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Acquire ability in solving mathematical problems numerically as applied to the respective branches of Engineering	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Apply the concept of interpolation for finding intermediate values of a well-known data			
CLR-3 :	Study the concept of numerical differentiation and integration			
CLR-4 :	Apply the numerical techniques for solutions of ordinary differential equations			
CLR-5 :	Apply the numerical techniques for solutions of partial differential equations			
CLR-6 :	Acquire analytical ability in solving mathematical problems numerically applied to the respective branches of Engineering			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Solve the algebraic, transcendental and simultaneous equations.	2	85	80	L	-	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-2 :	Find the finite differences and interpolation.	2	85	80	L	-	-	M	M	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Solve numerical Differentiation and integration.	2	85	80	-	M	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	Solve the numerical solutions of ordinary differential equations.	2	85	80	L	M	-	M	-	-	-	-	M	-	-	H	-	-	-
CLO-5 :	Solve the numerical solutions of partial differential equations	2	85	80	-	M	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Solve the problems numerically in science and engineering	2	85	80	H	-	H	-	-	-	-	-	H	-	-	H	-	-	-
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Method of Least Squares – Curve fitting.	First and Higher order differences.	Numerical Differentiation.	Numerical solutions for ordinary differential equations.	Numerical solutions for partial differential equations.
	SLO-2	Fitting a straight line.	Forward differences and backward differences.	Newton's forward difference formulae to compute first and higher order derivatives.	Solution by Taylor's series method.	Classification of partial differential equations.
S-2	SLO-1	Fitting a parabola.	Central Differences.	Newton's backward differences formulae to compute first and higher order derivatives.	Solutions of First order simultaneous differential equations by Taylor's series method.	Solution of Elliptic Equations.
	SLO-2	Calculation of the sum of the squares of the residuals of straight line and parabola.	Operators– Relations between the operators.	Problems by Newton's forward and backward differences formulae.	Euler's method.	Solution of Laplace Equations by Leibmann's Iterative process.
S-3	SLO-1	Solution of Algebraic and Transcendental equations.	Interpolation – Newton-Gregory Forward Interpolation formulae.	Applications of Newton's forward difference formulae to compute first and higher order derivatives.	Applications of Euler's method.	Solution of Laplace Equations by Leibmann's Iterative process.
	SLO-2	Newton-Raphson method.	Interpolation – Newton-Gregory Backward Interpolation formulae.	Applications of Newton's backward difference formulae to compute first and higher order derivatives.	Improved Euler's method.	Solution of Poisson Equations.
S-4	SLO-1	Problem solving using tutorial sheet 1.	Problem solving using tutorial sheet 4.	Problem solving using tutorial sheet 7.	Problem solving using tutorial sheet 10. Modified Euler's method	Problem solving using tutorial sheet 13.
	SLO-2					

S-5	SLO-1	*Bisection method and its applications.*	*Additional problems using Newton-Gregory Forward Interpolation formulae.*	*Additional problems for Newton's forward formulae to compute the application problems.*	*Applications of Improved and Modified Euler's method.*	*Problems for Poisson Equations.*
	SLO-2	*Problems using bisection method.*	*Additional problems using Newton-Gregory Backward Interpolation formulae.*	*Additional problems for Newton's backward formulae to compute the application problems.*	*Runge-Kutta method of fourth order.*	*Additional problems for Poisson Equations.*
S-6	SLO-1	*Regula-Falsi method.*	*Divided differences.*	*Numerical Integration.*	*Solution by Runge-Kutta method of fourth order.*	*Solution of Parabolic equations.*
	SLO-2	*Problems using false position method.*	*Formation of divided difference table.*	*Trapezoidal rule.*	*Additional problems using Runge-Kutta method of fourth order.*	*Bender-Schmidt formula*
S-7	SLO-1	*Solution of system of equations Direct Method - Gauss Elimination method.*	*Properties of Divided differences.*	*Simpson's one third rule.*	*Predictor-Corrector Methods.*	*Bender-Schmidt formula*
	SLO-2	*Solution of system of equations Direct Method – Gauss-Jordan method.*	*Properties of Divided differences.*	*Simpson's three eighth rule.*	*Milne-Thomson Method.*	*Bender-Schmidt formula*
S-8	SLO-1	*Problem solving using tutorial sheet 2.*	*Problem solving using tutorial sheet 5.*	*Problem solving using tutorial sheet 8.*	*Problem solving using tutorial sheet 11. Problems for Milne-Thomson Method.*	*Problem solving using tutorial sheet 14.*
	SLO-2					
S-9	SLO-1	*Solution of system of equations Iterative Method – Gauss- Jacobi method.*	*Newton's Divided difference formula.*	*More problems using Trapezoidal rule.*	*Application of Milne-Thomson Method.*	*Crank-Nicolson formula.*
	SLO-2	*Problems using Gauss-Jacobi method.*	*Problems by Newton's Divided difference formula.*	*More problems using Simpson's one third rule.*	*Adam's Bashforth method.*	*Crank-Nicolson formula.*
S-10	SLO-1	*Solution of system of equations Iterative Method – Gauss-Seidal method.*	*Additional problems by Newton's Divided difference formula.*	*More problems using Simpson's three eighth rule.*	*Problems using Adam's Bashforth method.*	*Crank-Nicolson formula.*
	SLO-2	*Problems using Gauss- Seidal method.*	*Lagrange's Interpolation formula.*	*Applications of Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules.*	*Application of Adam's Bashforth method.*	*Solution of Hyperbolic equations.*
S-11	SLO-1	*Power method.*	*Problems by Lagrange's Interpolation formula.*	*Application problems for Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules.*	*Additional problems for Milne-Thomson Method.*	*Solution of Hyperbolic equations by Explicit formula.*
	SLO-2	*Finding Eigen values by power method.*	*Inverse interpolation.*	*Applications problems for Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules.*	*Additional problems for Adam's Bash forth Method*	*More problems in Hyperbolic equations using Explicit formula.*
S-12	SLO-1	*Problem solving using tutorial sheet 3.*	*Problem solving using tutorial sheet 6.*	*Problem solving using tutorial sheet 9.*	*Problem solving using tutorial sheet 12.*	*Problem solving using tutorial sheet 15.*
	SLO-2	*Applications of numerical techniques to solve algebraic, transcendental and simultaneous equations*	*Application of interpolation for finding intermediate values of a well-known data*	*Applications of Numerical integration.*	*Applications of ordinary differential equation.*	*Applications of partial differential equation.*

Learning Resources	1. *B.S. Grewal, Numerical Methods in engineering and science, Khanna Publishers, 42nd edition, 2012* 2. *S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, 4th edition, 2005* 3. *E. Balagurusamy, Computer Oriented Statistical and Numerical Methods – Tata McGraw Hill., 2000*	4. *M.K.Jain, SRK Iyengar and R.L.Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd., 4th edition, 2003* 5. *Dr. M.K. Venkataraman, Numerical Methods in Science and Engineering, National Publishing Co., 2005*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. V. Maheshwaran, CTS, Chennai, maheshwaranv@yahoo.com	*1. Dr. K. C. Sivakumar, IIT, Madras, kcskumar@iitm.ac.in*	*1. Dr. A. Govindarajan, SRMIST*
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	*2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com*	*2. Dr. Sundarammal kesavan, SRMIST*

Course Code	18MAB203T	Course Name	PROBABILITY AND STOCHASTIC PROCESSES	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Describe the applications on discrete and continuous random variables.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Assess the applications of two dimensional random variables.			
CLR-3 :	Infer the various modes of convergence of random variables and their limit theorems.			
CLR-4 :	Relate the specialized knowledge in random processes in signals and systems.			
CLR-5 :	Determine the applications of spectral density functions and linear time invariant systems			
CLR-6 :	Interpret random variables and stochastic processes in the application of practical engineering problems.			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Compare the fundamentals between discrete and continuous random variables.	3	85	80	M	H	L	-	-	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Choose the model and analyze systems using two dimensional random variables.	3	85	80	M	H	-	M	M	-	-	-	M	-	-	H	-	-	-
CLO-3 :	Describe limit theorems using various inequalities.	3	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	Interpret the characteristics of random processes.	3	85	80	M	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Evaluate problems on spectral density functions and linear time invariant systems.	3	85	80	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Explain how random variables and stochastic processes can be described and analyzed.	3	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	One dimensional random variable: Discrete Case-Probability function, Cumulative Distribution Function	Two dimensional random variables-Discrete case	Limit theorems--Markov's inequality	Random Processes-Introduction	Power spectral density function- properties
	SLO-2	Continuous random variable-Probability density function	Probability function of (X,Y)-Marginal probability distribution	Chebyshev's inequality without proof	Classification of random processes	Proof of properties
S-2	SLO-1	Cumulative distribution function-properties	Conditional probability distribution of (X,Y)	Chebyshev's inequality - Applications	Distribution of the process	Problems on power spectral density function
	SLO-2	Problems on one dimensional random variables	Problems on discrete random variables	Chebyshev's inequality – Applications using Binomial distribution	Averages of the process	Problems on power spectral density function
S-3	SLO-1	Expectation, variance	Continuous random variables-Joint PDF	Chebyshev's inequality– Applications using Exponential distribution	Stationary, SSS,WSS processes	Power density spectrum
	SLO-2	Moments-raw and central moments	Marginal Probability distributions	The weak law of large numbers	Problems on stationary and SSS processes	Problems based on power density spectrum
S-4	SLO-1 SLO-2	Problem solving using tutorial sheet 1	Problem solving using tutorial sheet 4	Problem solving using tutorial sheet 7	Problem solving using tutorial sheet 10	Problem solving using tutorial sheet 13
S-5	SLO-1	Characteristic function - properties	Conditional probability distribution of (X,Y)	Central limit theorem without proof	Problems on WSS process	Linear system with random inputs
	SLO-2	Characteristic function	Problems on continuous two dimensional random variables	Central limit theorem - Applications	Problems on WSS process	Representation of system in the form of convolution
S-6	SLO-1	Binomial distribution -moments	Independent random variables	Central limit theorem- Applications using Poisson random variables	Autocorrelation function -properties	Unit impulse response of the system

	SLO-2	*Binomial distribution-Applications*	*Cumulative distribution function-properties of F(x,y)*	*Central limit theorem- Applications using Exponential random variables*	*Proof of properties*	*Properties*
S-7	SLO-1	*Poisson distribution-moments*	*Expected values of two dimensional random variables*	*The strong law of large numbers*	*Problems on autocorrelation function*	*Applications of unit impulse function*
	SLO-2	*Poisson distribution -Applications*	*Covariance and correlation*	*The strong law of large numbers*	*Application of autocorrelation function*	*Einstein Weiner- Khinchine Relationship*
S-8	SLO-1 SLO-2	*Problem solving using tutorial sheet 2*	*Problem solving using tutorial sheet 5*	*Problem solving using tutorial sheet 8*	*Problem solving using tutorial sheet 11*	*Problem solving using tutorial sheet 14*
S-9	SLO-1	*Exponential distribution-moments*	*Conditional expected values*	*One sided Chebychev's inequality*	*Cross correlation- properties*	*Problems on Khinchine relationship*
	SLO-2	*Exponential distribution-Applications*	*Problems on uncorrelated random variables*	*Cauchy Schwartz inequality*	*Proof of properties*	*Cross power density spectrum-properties*
S-10	SLO-1	*Normal Distribution-moments*	*Functions of two dimensional random variables*	*Chernoff bounds*	*Problems on cross correlation function*	*Properties of Power Spectral Density*
	SLO-2	*Normal Distribution-Applications*	*Probability density functions of the type Z=XY*	*Chernoff bounds for the standard normal variate*	*Ergodicity*	*Cross power density spectrum-problems*
S-11	SLO-1	*Function of a random variable*	*Probability density functions of the type Z=X-Y*	*Chernoff bounds for the Poisson random variate*	*Mean ergodic process*	*Cross power density spectrum*
	SLO-2	*Function of a random variable*	*Probability density functions of the type Z=X/Y*	*Jenson's inequality*	*Mean ergodic theorem*	*Cross power density spectrum*
S-12	SLO-1	*Problem solving using tutorial sheet 3*	*Problem solving using sheet 6*	*Problem solving using tutorial sheet 9*	*Problem solving using tutorial sheet 12*	*Problem solving using tutorial sheet 15*
	SLO-2	*Applications of random variables in engineering*	*Application of two dimensional random variables in Engineering*	*Applications of Central limit Theorem in engineering*	*Applications of random process in engineering*	*Applications of Power spectral density functions in engineering*

Learning Resources	1. *A. Papoulis, S. Uniikrishna Pillai, Probability, Random Variables and Stochastic Processes 4th ed., Mcgraw Hill, 2002* 2. *Henry Stark, Probability and Random Processes with Applications to Signal Processing, 3rd ed., Pearson, 2002* 3. *Sheldon Ross, A first course in Probability, 6th ed., 2011*	4. *S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 11th ed., 2015* 5. *Veerarajan T., Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks, 4th ed., McGraw-Hill Education, 2015*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
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2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	*2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com*	*2. Dr. V. Srinivasan, SRMIST*

Course Code	18MAB204T	Course Name	PROBABILITY AND QUEUEING THEORY	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	Apply and evaluating probability using random variables																		
CLR-2 :	Gain the knowledge and acquire the application of distribution to find the probability using Theoretical distributions																		
CLR-3 :	To Assess the appropriate model and apply and soling any realistic problem situation to determine the probability																		
CLR-4 :	To interpret the decision using Markov queueing applications																		
CLR-5 :	To construct chain of decisions from the past situations using Monrovians																		
CLR-6 :	Interpret random variables and Queuing theory in engineering problems.																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Solving problems on Discrete and Continuous Random variables	3	85	80	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-2 :	Identifying Distribution and solving the problems in Discrete and Continuous Distribution	3	85	80	M	H		M	M	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Decision Models using sampling techniques in Large and Small samples	3	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	Solving Queuing problems using Kendall's notation	3	85	80	M	H	-	-	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	To Evaluate the probability in uncertain situations using Markov chain rule	3	85	80	M	H	L	M	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Solving and analyzing the problems in random variables and Queuing theory.	3	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Probability Basic concepts and Axioms	Discrete Probability distribution	Sampling distribution, Null Hypothesis, Alternate Hypothesis	Introduction to F-test	Markov Process and Introduction of a Markov Chain
	SLO-2	Conditional probability, Multiplication theorem	Introduction to Binomial distribution	One tailed test, two tailed test	Problems on F-test	Past and Future -Step and State
S-2	SLO-1	Discrete and continuous Random variables	MGF, Mean, Variance of Binomial distribution	Level of significance,Critical region	Chi square test -Goodness of fit	One step Transition Probability N step transition Probability
	SLO-2	Probability mass function, cdf	Applications of Binomial distribution	Large samples test	Problems on Chi square test -Goodness of fit	Chapman-kolmogorov theorem definition
S-3	SLO-1	Continuous Random variables	Fit a Binomial distribution.	Student - t testSingle Proportion	Problems on Chi-square test Independent-Attributes	Initial Probability distribution problems Using Markov Chain
	SLO-2	pdf and cdf applications	Introduction to Poisson Distribution	Two Sample proportions	Problems on Chi-square test Independent-Attributes with standard distributions	Initial Probability distribution problems Using Markov Chain
S-4	SLO-1 SLO-2	Problem solving using tutorial sheet 1	Problem solving using tutorial sheet 4	Problem solving using tutorial sheet 7	Problem solving using tutorial sheet 10	Problem solving using tutorial sheet 13
S-5	SLO-1	Expectation and Variance	MGF , Mean , Variance of Poisson distribution	Large sample test-Single Mean	Introduction to Queueing Theory and Applications. Kendall, notation	Classification of States of a Markov Chain
	SLO-2	Problems on Expectation and Variance	Applications of Poisson Distribution	Difference of Means	Introduction toM/M/1 : infinity/ FIFO	Irreducible, Non irreducible, a period, Persistent, Non null Persistent
S-6	SLO-1	Moment Generating Function	Fit a Poisson Distribution	Problems on difference of Means	Ls, Lq, Ws,Wq	Problems on Classification of a Markov Chain

Course Code	18CEC201T	Course Name	ENGINEERING GEOLOGY	Course Category	C	Professional Core	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Identify the various geological processes			
CLR-2 :	Analyze the Minerals of Earth crust			
CLR-3 :	Analyze about the Rocks of the Earth Crust			
CLR-4 :	Interpret the various geological structures			
CLR-5 :	Utilize the geological investigations Techniques			
CLR-6 :	Identify Geological considerations for civil engineering projects			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Pro	Expected Attain	Program Learning Outcomes (PLO)														
					Engineering K	Problem A	Analysis	Design & Dev	Investigati	Modern Tool	Society & Cul	Environment	Ethics	Indivi	Communica	Project Mgt.	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify the geological agencies and their actions	2	85	80	H	-	-	-	-	-	M	-	L	-	-	H	H	-	-
CLO-2 :	Identify the physical property of rock forming minerals	2	85	75	H	-	-	-	-	-	M	-	L	-	-	H	H	-	-
CLO-3 :	Classify, Structure, Identify texture and the distribution of various types rocks	2	80	75	H	-	-	-	-	-	H	-	L	-	-	H	H	-	-
CLO-4 :	Interpret the various geological structure	2	85	80	H	-	-	-	-	-	H	-	L	-	-	H	H	-	-
CLO-5 :	Analyze the investigation techniques	3	85	75	H	-	H	M	-	-	H	-	M	-	-	H	H	-	-
CLO-6 :	Analyze the primary measures for civil engineering projects	3	80	75	H	H	H	H	-	-	H	-	M	-	-	H	H	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	***Applications of Geology in Civil Engineering***	***Physical properties of minerals and its identification methods***	***Rocks of the earth crust***	***Discontinuities in the rock & Structure of the rock***	***Geology for Engineering Projects -*** *Topography and types of land forms, reading of Toposheet*
	SLO-2	*Internal structure of Earth*	*Chemical and optical properties of minerals and its role in alkalinity reactivity*	*Types of rocks and kinds of building materials*	*Contour and drainage map analysis to determine the topography and slope of the ground*	*Geological mapping methods of a construction site*
S-2	SLO-1	*Endogenous process- Earthquake & Plate Tectonics*	*Physical properties of quartz group minerals and its optical properties, strained quartz analysis, cement bonding effects*	*Igneous rocks- types, composition and alteration process*	*Attitude of rocks - Dip & Strike*	*Geological mapping of subsurface topography*
	SLO-2	*Physical weathering-process, merits and demerits of weathering zones in project area*	*Physical properties of Feldspar group minerals and its optical properties. Chemical reaction of Feldspar and formation of clay*	*Igneous rocks- structure, veins and cave*	*Geological structures – Folds*	*Geophysical Investigations –Self potential method*
S-3	SLO-1	*Chemical and biological weathering process, merits and demerits of weathering zones in project area*	*Mica group of minerals , types and deleterious minerals*	*Engineering properties, of the Igneous rocks – Granite, Diorite, Dolerite, Basalt, Biotite, Granite, Felsic granite*	*Fold Classification*	*Geophysical Investigations – equipotential and potential drop method*
	SLO-2	*Products of weathering ,weathering grade analysis- with strength of the rocks*	*Mafic minerals , types and deleterious minerals , Identification of minerals. Quartz minerals-strained quartz analysis –cement bonding effects*	*Igneous rocks – composition and structure, response to rock strength Engineering properties of Igneous rocks as foundation rock and aggregates*	*Fold signification in geological investigations , Fold axis and determination of orientation of rock*	*Seismic methods-Reading seismic lines and deciphering subsurface strata / geology*
S-4	SLO-1	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***
	SLO-2	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***

S-5	SLO-1	*Groundwater- origin, factors of formation, types, water table, Groundwater quality*	*Pyroxene group of minerals*	*Sedimentary rocks- types*	*Geological structures – Fault*	*GPR technology and subsurface mapping Gravitational techniques*
	SLO-2	*Rainwater harvesting methods, Drainage patterns*	*Amphibole group of minerals*	*Conglomerate, Breccia, Sand and Sandstone, composition, quality analysis, alteration signatures*	*Fault Classification*	*Remote Sensing Techniques for civil engineering*
S-6	SLO-1	*Exploration method of Groundwater- Electrical resistivity survey technique*	*Gem group of minerals*	*Limestone, types, composition, properties, solution reactivity and cave formation*	*Fault classification*	*Applications of satellite mapping methods*
	SLO-2	*Geomorphic landforms performed at- Desert, lands (wind) merits and demerits for civil engineering projects*	*Properties of Gypsum*	*Clay minerals types formation and Engineering properties*	*Geological Structures – Joints*	*Geological considerations for dam*
S-7	SLO-1	*Geomorphic landforms performed by sea erosion, merits and demerits for civil engineering projects*	*Physical properties of Calcite*	*Engineering properties of the Sedimentary rocks-Breccia and Conglomerate, Sandstone and limestone*	*Joint classification*	*Geological considerations for dam*
	SLO-2	*Geomorphic landforms performed at ice covered lands, merits and demerits for civil engineering projects*	*Physical properties of Gypsum and Mica*	*Metamorphic rock types and description of Gneiss, Quartzite, Marble, Slate , Schist and Phyllite*	*Joint classification*	*Geological considerations for dam*
S-8	SLO-1	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***
	SLO-2	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***
S-9	SLO-1	*Geomorphic landforms performed at river erosion its merits and demerits for civil engineering projects*	*Clay minerals and types*	*Metamorphic rocks, textures and structures*	*Engineering considerations of Fold*	*Geological Considerations for reservoirs*
	SLO-2	*Landforms performed at river deposition, its merits and demerits for civil engineering projects*	*Clay properties as lining and filter materials*	*Engineering properties of metamorphic rocks*	*Engineering considerations of Fold*	*Geological Considerations for reservoirs*
S-10	SLO-1	*Coastal erosional and depositional land forms*	*Engineering properties of Clay*	*Preparation of Fence diagram and delineation of subsurface rock layers*	*Engineering considerations of Fault*	*Geological Considerations for hard and soft tunnels*
	SLO-2	*Sea water dynamics and coastal protection structures*	*Coal deposits and mines in India*	*Litho core/Borehole rock analysis*	*Engineering considerations of Fault*	*Geological considerations for tunnels and road cuts*
S-11	SLO-1	*Landslides, causes for landslides, factors.*	*Coal properties*	*Rock litho core analysis*	*Engineering considerations of Joint*	*Demonstration of Clinometer, Brunton, GPS and GPR*
	SLO-2	*Types of landslides, landslide mitigation structures*	*Petroleum deposits in India*	*Determination of rock strength*	*Engineering considerations of Joint*	*Identification of maps and type of soils*
S-12	SLO-1	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***
	SLO-2	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***	***Tutorial***

Learning Resources

1. *Garg .S.K, Physical and Engineering Geology, Khanna Publication, New Delhi, 1999*
2. *Parbin Singh, Engineering and General Geology, Katson Publication House, 2010*
3. *Maruthesha Reddy M.T, Engineering Geology Practical, New Age International Pvt Ltd, 2003*
4. *Legeet, Geology and Engineering, McGraw Hill Book Company, 1998*
5. *Blyth, Geology for Engineers, ELBS, 1995*
6. *NPTEL: Earth Sciences for Civil Engineering Part I. https://onlinecourses.nptel.ac.in/noc18_ce12/preview*
7. *NPTEL: Subsurface exploration : Importance and techniques. https://onlinecourses.nptel.ac.in/noc19_ce10/preview*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply / Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate / Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Dr. Sarunjith K J, National Centre for Sustainable Coastal Management, sarunjith@ncscm.res.in	*Dr. R. Nagendra, Anna University, geonag@gmail.com*	*Dr. R Annadurai, SRMIST*	*Dr. Sachikanta Nanda, SRMIST*
2. Dr. Nagasundaram M, Geological Survey of India, nagasundaram.m@gsi.gov.in	*Dr. S. G. D. Shreedhar, University of Madras, sgd.sri@unom.ac.in*	*Dr. Aparna S Bhaskar, SRMIST*	

Course Code	18CEC202L	Course Name	FLUID MECHANICS LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize pressure measurement for real-time applications			
CLR-2 :	Utilize buoyancy for real-time applications			
CLR-3 :	Analyze the applications of Bernoulli's principle			
CLR-4 :	Utilize the functions of orificemeter, venturimeter and pitot tube			
CLR-5 :	Identify the losses in pipes			
CLR-6 :	Utilize the functions of orifice and mouthpiece			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		Level o	Expected Pro	Expected Attain	Engineering K	Problem A	Design & Dev	Analysis	Modern Tool	Society & Cul	Environment	Ethics	Indiv	Communica	Project Mgt.	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Apply the concept of Pascal's law	3	90	85	H	M		-	-	-	-	-	H	-	-	-	H	-	H
CLO-2 :	Identify the applications of buoyancy	3	85	80	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-3 :	Identify the applications of Bernoulli's principle	3	90	85	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-4 :	Identify the working principle, components and functions of orificemeter, venturimeter and pitot tube	3	85	80	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-5 :	Estimate the losses in pipes	3	85	80	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-6 :	Identify the working principle, and functions of orifice and mouthpiece	3	85	80	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H

Duration (hour)		6	6	6	6	6
S 1-2	SLO-1	Determinepressure using U-tube manometer	Verify Bernoulli's equation	Determine coefficient of discharge for orificemeter	Determine coefficient of velocity for pitot tube	Determine loss coefficient for sudden enlargement
	SLO-2					
S 3-4	SLO-1	Determine metacentric height for a ship model	Determine coefficient of discharge for venturimeter	Measure flow using orificemeter	Determine friction factor of the pipe material	Determine coefficient of discharge of orifice
	SLO-2					
S 5-6	SLO-1	Determine metacentric height for a rectangular log	Measure flow using venturimeter	Determine coefficient of discharge for rotameter	Determine loss coefficient for sudden contraction	Determine coefficient of discharge of mouthpiece
	SLO-2					

Learning Resources	1. Modi, P.N., Seth S.M., Hydraulics and Fluid Machines, Standard book house, 2005 2. Subramanya, K., Theory and application of fluid mechanics, Tata McGraw Hill, 2002	3. Rajput. R. K, Fluid Mechanics and Hydraulic Machines, S.Chand and Company Ltd.,2013 4. Laboratory Manual for Hydraulic Engineering Laboratory, SRMIST

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	-	40 %	-	30 %	-	30 %	-	30 %	-	30%
Level 2	Apply / Analyze	-	40 %	-	40 %	-	40 %	-	40 %	-	40%
Level 3	Evaluate / Create	-	20 %	-	30 %	-	30 %	-	30 %	-	30%
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from Record and Model Examination.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Abdul Hakeem, National Remote Sensing Center, Hyderabad, abdulhakeem_k@nrsc.gov.in	1. Dr. R. Saravanan, Anna University, rsaran@annauniv.edu	1. Dr. R. Sathyanathan, SRMIST
2. Dr. Sat Kumar Tomer, Satyukt Analytics Pvt Ltd., Bengaluru, sat@satyukt.com	2. Dr. S. Saravanan, NIT Trichy, saravanans@nitt.edu	2. Mr. Shaik NiyazuddinGuntakal, SRMIST

Course Code	18CEC202T	Course Name	FLUID MECHANICS	Course Category	C	Professional Core	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning
		1 2 3
CLR-1 :	Utilize the various properties of fluids	
CLR-2 :	Analyze hydrostatics, buoyancy; stability of floating and submerged bodies	
CLR-3 :	Utilize pressure measuring devices	
CLR-4 :	Analyze concepts of fluid kinematics	
CLR-5 :	Apply fluid dynamics for practical applications	
CLR-6 :	Utilize the concepts of flow through pipes in real time applications	

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)															
		Level o	Expected Pro	Expected Attain	Engineering K	Problem A	Analysis	Design & Dev	Investigati	Modern Tool	Society & Cul	Environment	Ethics	Indivi	Communica	Project Mgt.	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify the various properties of fluid	2	85	80	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-	
CLO-2 :	Analyze hydrostatic pressure force	3	85	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-	
CLO-3 :	Apply hydrostatic laws in various pressure measuring devices	3	85	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-	
CLO-4 :	Identify the importance of fluid kinematics	2	85	80	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-	
CLO-5 :	Identify the applications of fluid dynamics	2	80	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-	
CLO-6 :	Analyze laminar and turbulent flow in pipes	3	85	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-	

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Fluid properties*** *Importance and application of fluid mechanics*	*U tube differential manometer, upright and inverted differential manometer*	*Stream line, path line, streak line and stream tube*	*Momentum equation*	*Pipes in series and parallel*
	SLO-2	*Distinction between fluid and solid, mass density, specific weight, specific gravity*	*Mechanical gauges*	*Velocity potential function*	*Force exerted by a flowing fluid on a pipe bend*	*Equivalent pipes*
S-2	SLO-1	*Newton's law of viscosity, kinematic and dynamic viscosity*	***Fluid statics*** *Hydrostatic pressure force: horizontal and vertical surfaces*	*Stream function*	*Free liquid jets, Maximum height attained by the jet*	*Flow through syphon*
	SLO-2	*Variation of viscosity with temperature and pressure*	*Hydrostatic pressure force: inclined surfaces*	*Flow net*	*Time of flight, time to reach highest point, horizontal range of the jet*	*Branching of pipes*
S-3	SLO-1	*Solving problems using tutorial sheet 1*	*Solving problems using tutorial sheet 4*	*Solving problems using tutorial sheet 7*	*Solving problems using tutorial sheet 10*	*Solving problems using tutorial sheet 13*
	SLO-2	*Solving problems using tutorial sheet 1*	*Solving problems using tutorial sheet 4*	*Solving problems using tutorial sheet 7*	*Solving problems using tutorial sheet 10*	*Solving problems using tutorial sheet 13*
S-4	SLO-1	*Surface tension on liquid droplet, hollow bubble and liquid jet*	*Hydrostatic pressure force on curved surfaces*	*Control volume, continuity equation in cartesian coordinate system*	***Flow through pipes***	*Two reservoir problem*
	SLO-2	*Capillarity*	*Buoyancy, center of buoyancy*	*Forced vortex flow and free vortex flow*	*Laminar flow in circular pipes, Hagen–Poiseuille equation*	*Three reservoir problem*
S-5	SLO-1	*Bulk modulus of elasticity, compressibility*	*Metacenter and metacentric height*	***Fluid dynamics***	*Turbulent flow in pipes, Velocity distribution for turbulent flow*	*Water hammer in pipes*
	SLO-2	*Vapour pressure, boiling point and cavitation*	*Stability of floating and submerged bodies*	*Euler's equation and Bernoulli's equation*	*Reynolds experiment, frictional loss in pipe flow, Darcy Weisbach equation, minor energy losses*	*Power transmission through pipe*
S-6	SLO-1	*Solving problems using tutorial sheet 2*	*Solving problems using tutorial sheet 5*	*Solving problems using tutorial sheet 8*	*Solving problems using tutorial sheet 11*	*Solving problems using tutorial sheet 14*
	SLO-2	*Solving problems using tutorial sheet 2*	*Solving problems using tutorial sheet 5*	*Solving problems using tutorial sheet 8*	*Solving problems using tutorial sheet 11*	*Solving problems using tutorial sheet 14*
S-7	SLO-1	*Fluid pressure at a point, Pascal's law*	***Fluid kinematics***	*Practical applications of Bernoulli's equation, venturimeter*	*Loss due to sudden enlargement and contraction*	*Condition for maximum power transmission*
	SLO-2	*Pressure variation in a fluid at rest; absolute and gauge pressures*	*Classification of fluid flow*	*Horizontal, vertical and inclined venturimeters*	*Loss of head at the entrance and exit of the pipe*	***Boundary layer theory*** *Boundary layer definitions and*

						characteristics
S-8	SLO-1	*Piezometer, U-tube manometer*	*Velocity and acceleration*	*Orificemeter*	*Loss of head due to an obstruction in a pipe*	*Boundary layer thickness and displacement thickness*
	SLO-2	*Single column manometer*	*Local acceleration and convective acceleration*	*Pitot tube*	*Hydraulic Gradient Line (HGL) and Total Energy Line (TEL)*	*Momentum thickness and energy thickness*
S-9	SLO-1	*Solving problems using tutorial sheet 3*	*Solving problems using tutorial sheet 6*	*Solving problems using tutorial sheet 9*	*Solving problems using tutorial sheet 12*	*Solving problems using tutorial sheet 15*
	SLO-2	*Solving problems using tutorial sheet 3*	*Solving problems using tutorial sheet 6*	*Solving problems using tutorial sheet 9*	*Solving problems using tutorial sheet 12*	*Solving problems using tutorial sheet 15*

Learning Resources	*1. Modi, P.N., Seth S.M., Hydraulics and Fluid Machines, Standard book house, 2005* *2. Subramanya, K., Theory and application of fluid mechanics, Tata McGraw Hill, 2002*	*3. Rajput R.K., Fluid Mechanics and Hydraulic Machines, S.Chand, 2014* *4. Bansal R.K., Fluid Mechanics and Hydraulic Machines, Laxmi Publication, 2017* *5. NPTEL Course - Introduction to Fluid Mechanics https://onlinecourses.nptel.ac.in/noc19_me15/preview*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Abdul Hakeem, National Remote Sensing Center, Hyderabad, abdulhakeem_k@nrsc.gov.in	*1. Dr. R. Saravanan, Anna University, rsaran@annauniv.edu*	*1. Dr. R. Sathyanathan, SRMIST*
2. Dr. Sat Kumar Tomer, Satyukt Analytics Pvt Ltd., Bengaluru, sat@satyukt.com	*2. Dr. S. Saravanan, NIT Trichy, saravanans@nitt.edu*	*2. Dr. Deeptha Thattai, SRMIST*

Course Code	18CEC203L	Course Name	STRENGTH OF MATERIALS LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize the testing procedure to determine modulus of elasticity of steel, double shear test and hardness test			
CLR-2 :	Utilize the testing procedure of torsional, impact strength of steel and also compressive strength of bricks and concrete			
CLR-3 :	Utilize non-destructive testing technique of rebound hammer and UPV tests			
CLR-4 :	Determine the stiffness and deflection of helical springs			
CLR-5 :	Determine modulus of elasticity of concrete, split tensile strength and flexural strength of concrete			
CLR-6 :	Utilize the testing procedure to determine bond strength between steel bar and concrete (pull-out test)			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning Level	Expected Proficiency	Expected Attainment	Program Learning Outcomes (PLO) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis	Modern Tool	Society & Culture	Environment	Ethics	Indiv	Communica	Project Mgt.	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Determinemodulus of elasticity of steel, double shear test and hardness test	3	90	85	H	M		-	M	-	-	-	H	-	-	-	H	-	H
CLO-2 :	Identify torsional, impact strength of steel, identify compressive strength of bricks and concrete	3	85	80	H	M	-	-	M	-	-	-	H	-	-	-	H	-	H
CLO-3 :	Apply the knowledge of non-destructive testing technique of rebound hammer and UPV tests	3	90	85	H	H	-	-	M	-	-	-	H	-	-	-	H	-	H
CLO-4 :	Compute stiffness and deflection of helical springs	3	85	80	H	M	-	-	M	-	-	-	H	-	-	-	H	-	H
CLO-5 :	Determine modulus of elasticity of concrete, split tensile strength and flexural strength of concrete	3	85	80	H	M	-	-	M	-	-	-	H	-	-	-	H	-	H
CLO-6 :	Find bond strength between steel bar and concrete (pull-out test)	3	85	80	H	M	-	-	M	-	-	-	H	-	-	-	H	-	H

Duration (hour)		6	6	6	6	6
S 1-2	SLO-1	Determination of strength of steel specimen under impact test -Izod Test	Determination of strength of steel specimen under double shear test.	Determination of stiffness and deflection of helical springs.	Determination of split tensile strength of concrete cylinder.	NonDestructive Test using rebound hammer and UPV.
	SLO-2					
S 3-4	SLO-1	Determination of strength of steel specimen under torsion test.	Determination of strength of concrete cube and bricks under compression tests.	Determination of strength of steel specimen under impact test - Charpy Test	Determination of flexural strength of concrete beam (two point load test).	To study the behavior of Castellated steel beam
	SLO-2					
S 5-6	SLO-1	Determination of hardness strength test on specimen using Rockwell &Brinell.	Deflection test on steel, aluminum specimens under central and non-central point load.	Determination of modulus of elasticity of steel from stress-strain graph by conducting tension test on steel.	Determination of bond strength between steel bar and concrete (pull-out test).	To study the stress patterns on different models using photo elasticity test-Demo
	SLO-2					

Learning Resources	
1. IS 5816:1999 (Reaffirm – 2004), Splitting Tensile Strength of Concrete-Method of Test, Bureau of Indian Standards, New Delhi.	3. IS 516:1959 (Reaffirm – 2004), Method of Tests for Strength of Concrete, Bureau of Indian Standards, New Delhi.
2. Strength of Materials Laboratory - Laboratory Manual, SRMIST	4. IS 1500:2005, Method for Brinell Hardness Test for Metallic Materials -Method of Test, Bureau of Indian Standards, New Delhi.

Learning Assessment		Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
	Bloom's Level of Thinking	CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	40 %	-	30 %	-	30 %	-	30 %	-	30%
	Understand										
Level 2	Apply	-	40 %	-	40 %	-	40 %	-	40 %	-	40%
	Analyze										
Level 3	Evaluate	-	20 %	-	30 %	-	30 %	-	30 %	-	30%

	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from Record and Model Examination.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Er. G.Hariharanath, GA Consultants, Chennai, gac1996@hotmail.com	*1. Dr. G. Appa Rao, Professor, IIT Madras, garao@iitm.ac.in*	*1. Dr. K.Gunasekaran, SRMIST*
2. Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai, desigan.agv@gmail.com	*2. Dr. C. Uma Rani, Professor, Anna University, umarani@annauniv.edu*	*2. Dr. P.R.Kannan Rajkumar, SRMIST*

Course Code	18CEC203T	Course Name	MECHANICS OF STRUCTURES	Course Category	C	*Professional Core*	L	T	P	C
							2	1	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes/Standards**	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**		
		1	2	3
CLR-1 :	*Utilize the concepts of stresses in compound sections and principal stresses and principal strains*			
CLR-2 :	*Analyze determinate beams for bending moment and shear force*			
CLR-3 :	*Utilize computation of stresses in beam cross section*			
CLR-4 :	*Utilize computation of slope and deflection of beams and analysis of determinate and indeterminate trusses*			
CLR-5 :	*Analyze columns and application of theories of failures*			
CLR-6 :	*Utilize concepts of static indeterminacy and analysis of indeterminate beams*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level o	Expected Prof	Expected Attain	**Program Learning Outcomes (PLO)**														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering K	Problem A	Design & Dev	Investi	Modern Tool	Society & Cul	Environment	Ethics	Indivi	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*Analyze the state of stress, evaluate principal stresses and principal strains including stresses in compound sections*	*3*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	*H*
CLO-2 :	*Determine bending moment and shear force distribution along the beam*	*3*	*85*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	*H*
CLO-3 :	*Determine bending and shear stress distribution across the cross section of rectangular, 'I', 'T' sections.*	*3*	*75*	*75*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	*H*	-	*H*
CLO-4 :	*Compute slope, deflection of beams (Macaulay's, conjugate beam method) analyze determinate, indeterminate trusses*	*3*	*90*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	*H*
CLO-5 :	*Analyze columns using Euler's, Rankine's theories of columns, theories of failure in real time applications*	*3*	*85*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	*H*
CLO-6 :	*Apply Macaulay's method, Clapeyron's theorem to solve indeterminate beam problems*	*3*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***STRESSES IN COMPOUND SECTIONS*** *Principles of composite sections*	***DETERMINATE BEAMS – BENDING AND SHEAR FORCE DIAGRAMS*** *Determinate structures, Types of beams, load and its types.*	***DETERMINATE BEAMS – SLOPE AND DEFLECTION*** *Definition of slope and deflection:*	***COLUMNS*** *Classifications of columns, failure of column*	***INDETERMINATE BEAMS*** *Introduction to static & kinematic indeterminacy*
	SLO-2	*Analysis of compound sections*	*Shear force and bending moments: definitions, sign conventions*	*Definition of elastic line, differential equation of flexure*	*Euler's column theory limitations, end conditions, effective length, slenderness ratio*	*Static and kinematic indeterminacy of two and three dimensional pin jointed structures*
S-2	SLO-1	*Thermal stresses and strains*	*BM diagrams plotted on tension side, SF diagrams, cantilever beams*	*Slope and deflections of determinate structures - Macaulay's method*	*Solving Problems*	*Static and kinematic Indeterminacy of two and three dimensional rigid jointed structures*
	SLO-2	*Simple and compound bars.*	*SF and BM diagrams for simply supported beams*	*Solving Problems*	*Solving Problems*	*Analysis of indeterminate beams, propped cantilever beams - Macaulay's method*
S-3	SLO-1	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*
	SLO-2	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*
S-4	SLO-1	***STRESSES AT A POINT*** *Introduction to principal stresses and strains*	*SF and BM diagrams for over-hanging beams*	*Slope and deflections of determinate structures - Conjugate beam method.*	*Rankine's formula, factor of safety*	*Analysis of fixed beam by Macaulay's method*
	SLO-2	*Two dimensional stresses without shear stress*	*Beams with internal hinges, point of contra flexure*	*Solving Problems*	*Column with eccentricity, core / kernel section.*	*Introduction to Clapeyron's theorem of three moments*
S-5	SLO-1	*Two dimensional stresses, Like and unlike stresses, with shear stress*	*Relationship between load, shear force and bending moment.*	***PIN JOINTED TRUSSES*** *Analysis of determinate trusses.*	***THEORIES OF FAILURES*** *Introduction to theories of failures*	*Analysis - Continuous beams*

	SLO-2	*Introduction to three dimensional stresses*	***BENDING / SHEAR STRESSES**: Pure bending, bending equation – Bending / Shear stress distribution*	*Determination of deflection at the tip of the cantilever determinate truss*	*Application of maximum principal stress theory*	*Analysis of continuous beams with settlement of supports*
S-6	SLO-1	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*
	SLO-2	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*
S-7	SLO-1	*Three dimensional stresses, stress invariants.*	*Neutral axis, moment of resistance, section modulus*	*Indeterminate trusses - Energy method - Analysis of indeterminate pin jointed - Plane trusses of degree of indeterminacy equal to 1*	*Application of maximum principal strain theory*	*Solving problems on two span continuous beam with simple supports*
	SLO-2	*Stresses in thin cylinder and spherical shells*	*Bending stresses, symmetrical sections.*	*Analysis of trusses due to lack of fit*	*Application of stress difference theory*	*Solving problems on two span continuous beam end support (s) fixed*
S-8	SLO-1	*Concept of product of inertia, parallel axes theorem*	*Shear stresses: Shear stress at a section, shear flow*	*Analysis of trusses subjected to temperature effects.*	*Application of strain energy theory*	*Solving three span continuous beams with simple end supports and fixed end supports.*
	SLO-2	*Principal moment of inertia*	*Shear stress distribution for different sections.*	*Concept of solving indeterminate trusses with degree of indeterminacy greater than one*	*Application of shear strain energy theory*	*Principle of forming deflection equation - Macaulay's method.*
S-9	SLO-1	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*
	SLO-2	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*	*Tutorials*

Learning Resources	*1. Devdas Menon, Structural Analysis, 1st ed., Narosa, 2013* *2. R.C.Hibbeler,Structural Analysis, 9th ed., Pearson India, 2017* *3. R.C.Hibbeler, Mechanics of Materials, 9th ed.,Pearson India, 2018* *4. Ramamamrutham.S, Narayan.R, Strength of Materials, 18th ed., Dhanpat Rai Publishing Company, 2014*	*5. Rajput.R. K, Strength of Materials: Mechanics of Solids,5th ed., S. Chand Limited, 2010* *6. Punmia.B.C, Ashok.K.Jain, Arun.K.Jain, Theory of Structures, 12th ed., Laxmi Publications, 2014* *7. NPTEL Course: Mechanics of Solids. https://onlinecourses.nptel.ac.in/noc17_ce17/preview* *8. NPTEL Course: Strength of Materials https://onlinecourses.nptel.ac.in/noc18_ce17/preview*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

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1. Er. G.Hariharanath, GA Consultants, Chennai, gac1996@hotmail.com	*1. Dr. G. Appa Rao, Professor, IIT Madras, garao@iitm.ac.in*	*1. Dr. K. Gunasekaran, SRMIST*
2. Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai, desigan.agv@gmail.com	*2. Dr. C. Uma Rani, Professor, Anna University, umarani@annauniv.edu*	*2. Dr. P. R. Kannan Rajkumar, SRMIST*

Course Code	18CEC204L	Course Name	ENGINEERING SURVEYING LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize the principles of chain surveying			
CLR-2 :	Utilize the principles of compass surveying			
CLR-3 :	Utilize the application of principles of plane table surveying			
CLR-4 :	Utilize the principles of levelling			
CLR-5 :	Utilize the principles of operation of theodolite			
CLR-6 :	Apply theodolite principle for measuring height and distance			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Prof	Expected Attain	Program Learning Outcomes (PLO)														
					Engineering Kn	Problem Ana	Design & Dev	Analysis	Modern Tool	Society & Cul	Environment	Ethics	Indiv	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Traverse and prepare the site layout	3	90	85	H	H	L	-	L	-	-	-	H	H	-	-	H	-	H
CLO-2 :	Traverse, resulting in precise location of points using prismatic compass	3	85	80	H	H	L	-	L	-	-	-	H	H	-	-	H	-	H
CLO-3 :	Prepare site layouts	3	80	75	H	H	M	-	M	-	-	-	H	H	-	-	H	-	H
CLO-4 :	Profile land levels and contouring	3	85	80	H	H	M	-	M	-	-	-	H	H	-	-	H	-	H
CLO-5 :	Determine horizontal distance of the inaccessible target	3	85	80	H	H	H	-	M	-	-	-	H	H	-	L	H	-	H
CLO-6 :	Estimate the height of inaccessible target	3	80	75	H	H	H	-	M	-	-	-	H	H	-	L	H	-	H

Duration (hour)		6	6	6	6	6
S 1-2	SLO-1	Chain surveying, Calculation of area using cross staff by Perpendicular offset	Traversing, Prismatic compass, Running closed and open compass traverse, plotting and adjustments of traverse	Resection, Field solution of two point problems	Reduction of levels by Rise and Fall method	Theodolite, Measure vertical angles and Height of the object
	SLO-2					
S 3-4	SLO-1	Chain surveying, Calculation of area using cross staff by oblique offset	Plane table Surveying by Intersection Method	Resection, Field solution of Three point problems (Trial and Error method)	Theodolite, Measure horizontal angles by repetition method	Height and distance by Single Plane Method
	SLO-2					
S 5-6	SLO-1	Traversing, measurement of bearing of survey lines by prismatic compass and correction of Local Attraction	Plane table Surveying by Radiation Method	Reduction of levels by Height of Collimation method	Theodolite, Measure horizontal angles by reiteration method	Height and distance by Double Plane Method
	SLO-2					

Learning Resources	1. Punmia B.C, Surveying, Vols. I, 17th ed., Laxmi Publications, 2016 2. Bhavikatti, S.S, Surveying and Leveling, Vol. I and II, I.K. International, 2010	3. Surveying Manual - SRMIST

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	40 %	-	30 %	-	30 %	-	30 %	-	30%
	Understand										

Level 2	Apply Analyze	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
Level 3	Evaluate Create	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from Record and Model Examination.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai, desigan.agv@gmail.com	*2. Dr. E.S.M. Suresh, NITTTR, Chennai, esmsuresh@gmail.com*	*2. Dr. J. Satish Kumar, SRMIST*

Course Code	18CEC204T	Course Name	ENGINEERING SURVEYING	Course Category	C	Professional Core	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize chain, compass & Plane table surveying			
CLR-2 :	Utilize concepts of levelling			
CLR-3 :	Utilize working procedures of theodolite surveying			
CLR-4 :	Utilize operations of tachometric surveying			
CLR-5 :	Utilize the knowledge of surveying in carrying out Civil Engineering works			
CLR-6 :	Estimate the capacity of reservoirs, areas of embankments & setting out foundation trenches and curves			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level	Expected Prof.	Expected Attain	Program Learning Outcomes (PLO)															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
					Engineering K	Problem Anal	Design & Dev	Analysis	Modern Tool	Society & Cul	Environment	Ethics	Indiv	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3	
CLO-1 :	Apply the principles and making of linear, direction measurements and creation of Plan/Map	2	90	80	H	H	-	-	L	-	-	-	-	M	-	-	H	-	-	
CLO-2 :	Determine or set the altitude of the point/or set of points w.r.t the given datum	3	85	75	H	H	-	-	M	-	-	-	-	M	-	-	H	-	-	
CLO-3 :	Measure the horizontal and vertical angle and derive the measurements at times of obstacle and inaccessible points	3	80	75	H	H	-	-	M	-	-	-	-	M	-	-	H	-	-	
CLO-4 :	Apply knowledge of optics to make the angular measurements in rolling/hilly terrain	3	85	80	H	H	-	-	M	-	-	-	-	M	-	-	H	-	-	
CLO-5 :	Set horizontal, vertical control and setting out works	2	85	80	H	H	-	-	H	-	M	-	-	M	-	M	H	-	-	
CLO-6 :	Calculate areas, volumes and setting out curves	3	80	75	H	H	-	-	H	-	M	-	-	M	-	M	H	-	-	

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Surveying*** *Definition, Principles of Surveying*	*Methods: Radiation, Intersection*	***Theodolite*** *Vernier & microptic, description and uses Temporary Adjustments of Vernier transit*	*Horizontal & Vertical for staff held Inclined Elevation & Depression on Fixed Hair Systems, with and without Analytic Lens*	*Layout, setting out works for foundation trenches*
	SLO-2	*Classification of Surveying, Chain: Description, types of Chain & Accessories*	*Resection: two point & three-point Problem*	*Permanent Adjustments of the Vernier transit*	*Horizontal & Vertical for Normal staff Elevation & Depression. On Fixed Hair Systems, with & without Analytic Lens*	*Curves: Description & Components, Horizontal and Vertical curves, types*
S-2	SLO-1	*Conventional signs, Field & office work chaining*	*Levelling: Level Line, Horizontal Line, horizontal plane*	*Horizontal angles measurements: Radiation & Repetition Method*	*Movable Hair methods: Principle, Stadia constants, Analytic Lens*	*Simple curves: Terms & Components*
	SLO-2	*Ranging: Direct & Reciprocal ranging Procedures*	*Vertical Plane, datum, vertical line, elevation. Levels and Staves & types*	*Traversing, Closing error & distribution, Trigonometrical levelling: Heights & Distances*	*Tangential Systems: Both Angles of Elevation*	*Methods of Simple curves: setting with chain and tapes, Setting out procedure*
S-3	SLO-1	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*
	SLO-2	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*
S-4	SLO-1	*Setting perpendiculars, Well- conditioned triangles*	*Spirit level, sensitiveness, Bench marks & important Terminology in Levelling*	*Base of the object accessible, Base of the object Inaccessible: Instrument station in the same vertical Plane as Elevated Object. (Single Plane*	*Tangential Systems: Both Angles are angles of Depression*	*Methods of Simple curves Rankie's method: Tangential angles by theodolite (Single Theodolite Method)*

				Method)		
	SLO-2	*Compass: Prismatic compass, Surveyor's compass*	*Temporary Adjustments of Vernier Transit*	*Base of the object Inaccessible: Instrument station in the same vertical Plane as Elevated Object*	*Tangential Systems: One Angle of Elevation and Other of Depression*	*Methods of Simple curves* *Rankie's method: tangential angles by theodolite(Double Theodolite Method)*
S-5	SLO-1	*Meridians, Bearings & Types, Bearing systems &Types*	*Permanent adjustments of Vernier transit*	*Base of the object Inaccessible: Instrument station in the same vertical Plane as Elevated Object: Axis at different Levels*	*Substence Bar Method*	*Setting out procedure by Rankie's method, compound and reverse curves, Transition curves*
	SLO-2	*Conversions, Bearings to angles, Local Attraction: Definition & Corrections applied for Local Attraction*	*Longitudinal & cross-sectional Levelling & plotting*	*Base of the object Inaccessible: Instrumental Station not in the same vertical plane as the elevated object. (Double Plane Method)*	*Self-Reducing Tachometers*	*Contours: Definition, Contour Interval & Consideration Factors*
S-6	SLO-1	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*
	SLO-2	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*
S-7	SLO-1	*Adjustment of error, Graphical Method*	*Fly & Check Levelling, Height of collimation, rise & fall Method Booking & Reduction Types*	***Tacheometric Systems**: Merits of tacheometric Systems, Types Tangential, Stadia & Substense methods*	***Engineering Surveys**: Reconnaissance, Preliminary surveys for Engineering Projects*	*Contours, Contouring Methods*
	SLO-2	*Magnetic declination, dip, Traversing, Types & Plotting*	*Gradient & Missing Values on booking & Reduction*	*Stadia Systems: types, Principle of stadia systems*	*Location surveys for Engineering Projects*	*Characteristics of contours*
S-8	SLO-1	*Plane Table Surveying: Plane table instruments and accessories*	*Booking & Reduction on levelling for inverted staff*	*Fixed Hair systems: stadia constants, analytic lens*	*Setting out Works, Aims* *Horizontal Control, Vertical control*	*Uses of contours*
	SLO-2	*Merits and demerits of Plane Table, & Operations of Plane Table*	*Curvature, Refraction & combined correction, Reciprocal Levelling*	*Horizontal & Vertical for staff held Inclined Elevation & Depression on Fixed Hair Systems*	*Base Lines & Types of Grids for carrying setting out works*	*Plotting – Calculation of areas and volumes*
S-9	SLO-1	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*
	SLO-2	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*	*Tutorial: Solving Problems*

Learning Resources	*1. Kanetkar T., Surveying and Levelling, Vols. I &II, United Book Corporation, Pune, 2007* *2. Punmia B.C, Surveying, Vols. I, 17th ed., Laxmi Publications, 2016* *3. Chandra A.M, Plane Surveying and Higher Surveying, 3rd ed., New Age International (P) Limited, 2015* *4. Clark.D, Plane and Geodetic Surveying, Vols. I & II, 17th ed., C.B.S. Publishers and Distributors, 2002*	*5. Punmia B.C, Surveying, Vols. II, 16th ed., Laxmi Publications, 2016* *6. James M. Anderson, Edward M. Mikhail, Introduction to Surveying, 3rd ed., McGraw Hill, 2001* *7. N N Basak, Surveying & Levelling, 1st ed., Tata Mc Graw Hill, 2015* *8. Arora K.P, Surveying, Vol. 3,11th ed., Standard Book House, 2013* *9. NPTEL course: Surveying (Web). https://nptel.ac.in/courses/105107122/1*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
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Course Code	18CEC205L	Course Name	COMPUTER AIDED STRUCTURAL ANALYSIS LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize the Calculate the Area of Steel of beams using MS Excel program			
CLR-2 :	Utilize the method of solving Matrix Equation using Stiffness Matrix			
CLR-3 :	Analyze behavior of 2D and 3D Moment Resistant Steel Frames using STAAD Pro or ETABS			
CLR-4 :	Analyze behavior of Plane Steel Frames using STAAD Pro or ETABS			
CLR-5 :	Utilize the flexural and shear behavior of RCC beam			
CLR-6 :	To get knowledge on the torsional behavior of RCC beam			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Prof	Expected Attain	Program Learning Outcomes (PLO)														
					1 Engineering Kn	2 Problem Anal	3 Design & Dev	4 Conduct Invest	5 Modern Tool	6 Society & Cult	7 Environment	8 Ethics	9 Indiv	10 Communica	11 Project Mgt.	12 Life Long L	13 PSO - 1	14 PSO - 2	15 PSO - 3
CLO-1 :	Calculate the Area of Steel of beams using MS Excel program	3	90	85	H	M	H	-	H	-	-	-	H	-	-	-	H	H	H
CLO-2 :	Solve matrix equation using stiffness matrix	3	85	80	H	M	-	-	H	-	-	-	H	-	-	-	H	H	H
CLO-3 :	Report on the behavior of 2D and 3D Moment Resistant Steel Frames	3	90	85	H	M	-	-	H	-	-	-	H	-	-	-	H	H	H
CLO-4 :	Analyze the behavior of Plane Steel Frames	3	85	80	H	M	-	-	H	-	-	-	H	-	-	-	H	H	H
CLO-5 :	Analyze the Flexural and shear resistance of RCC beams	3	85	80	H	M	-	-	H	-	-	-	H	-	-	-	H	-	H
CLO-6 :	Design the beam for torsion	3	85	80	H	M	M	-	H	-	-	-	H	-	-	-	H	-	H

Duration (hour)		6	6	6	6	6
S 1-2	SLO-1	Programming in MS Excel for calculating A_{st}	Solving Matrix Problems in MS Excel	Exercise the solution in STAAD Pro or ETABS	Analysis in STAAD Pro or ETABS for moving IRC loads and verification	Study the behavior of RCC beam test under flexure
	SLO-2					
S 3-4	SLO-1	Solving Problems in MS Excel	2D and 3D Moment Resistant Steel Frames Using STAAD Pro or ETABS for real building model	Exercise the solution in STAAD Pro or ETABS	Plane Pin Jointed Steel Frames using STAAD Pro or ETABS	Study the behavior of RCC beam test under shear
	SLO-2					
S 5-6	SLO-1	Solving Matrix Equation using Stiffness Matrix	Exercise the solution in STAAD Pro or ETABS	Exercise the solution in STAAD Pro or ETABS and verification using text book problems	Exercise the solution in STAAD Pro or ETABS and verification using text book problems	Study the behavior of RCC beam test under torsion
	SLO-2					

Learning Resources	1. IS 456 :2000, Plain and Reinforced Concrete: Code of Practice, Bureau of Indian Standards, New Delhi.	2. Laboratory Manual - SRMIST

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	40 %	-	30 %	-	30 %	-	30 %	-	30%
	Understand										
Level 2	Apply	-	40 %	-	40 %	-	40 %	-	40 %	-	40%
	Analyze										
Level 3	Evaluate	-	20 %	-	30 %	-	30 %	-	30 %	-	30%

	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from Record and Model Examination.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Er. G.Hariharanath, GA Consultants, Chennai, gac1996@hotmail.com	*1. Dr. G. Appa Rao, Professor, IIT Madras, garao@iitm.ac.in*	*1. Dr. K. S. Satyanarayanan, SRMIST*
2. Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai, desigan.agv@gmail.com	*2. Dr. C. Uma Rani, Professor, Anna University, umarani@annauniv.edu*	*2. Prof. G. Augustine Maniraj Pandian, SRMIST*

Course Code	18CEC205T	Course Name	STRUCTURAL ANALYSIS	Course Category	C	Professional Core	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	IS 9282: 2002 Indian Standard Wire Ropes and Strands for Suspension Bridges – Specifications		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Understand the behavior of indeterminate structures using slope deflection method			
CLR-2 :	Apply moment distribution method in the analysis of indeterminate structures			
CLR-3 :	Get exposed to stiffness matrix method			
CLR-4 :	Analyze indeterminate structures using flexibility matrix method			
CLR-5 :	Understand the behavior of determinate and indeterminate structures under moving loads			
CLR-6 :	Get an insight into the behavior of arches and suspension bridges			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Prof	Expected Attain	Program Learning Outcomes (PLO)														
					1 Engineering Kn	2 Problem Anal	3 Design & Deve	4 Analysis	5 Modern Tool	6 Society & Cult	7 Environment	8 Ethics	9 Indiv	10 Communica	11 Project Mgt.	12 Life Long L	13 PSO - 1	14 PSO - 2	15 PSO - 3
CLO-1 :	Apply slope deflection method to analyze indeterminate beams and plane rigid jointed frames	3	90	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Use moment distribution method to analyze indeterminate beams and plane rigid jointed frames	3	95	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-3 :	Make use of computer based matrix stiffness method and direct stiffness method to analyze indeterminate beams and plane rigid jointed frames	3	90	75	H	H	-	M	M	-	-	-	-	-	-	-	H	M	-
CLO-4 :	Apply energy concepts and matrix flexibility method to analyze indeterminate beams and plane rigid jointed frames	3	80	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-5 :	Draw influence line diagrams for determinate and indeterminate structures and apply the same for determinate and indeterminate structures for finding stress resultants due to moving loads	3	95	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-6 :	Analyze three hinged parabolic, circular arches and two hinged parabolic arches and study concepts behind the analysis of fixed arches. Analyze suspension cables and get an insight into to suspension bridges with two and three hinged girders	3	85	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-

		Influence Lines Diagrams (ILD) and Moving Loads	Arches and Suspension Bridges	Flexibility Matrix Method	Slope Deflection and Moment Distribution Methods	Direct and Element Stiffness Matrix Methods
Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to influence line diagram (ILD) and Muller Breslau's principle	Introduction to arches – three hinged, two hinged, fixed – Eddy's theorem – theoretical arch	Revisiting Castigliano's energy theorems	Fixed end moments, effect of rotations and settlement on support moments	Relation between SDM and matrix stiffness method and derivation of direct stiffness method equation, Advantages of Stiffness method over flexibility method
	SLO-2	ILD for BM and SF for cantilever	Analysis of three hinged parabolic arches with supports at the same level	Formation of basic determinate structure of an indeterminate structure by releasing the redundant reactions or inserting hinges	Principle of superposition and joint equilibrium and derivation of slope deflection method (SDM)	Analysis of propped cantilever using direct stiffness method
S-2	SLO-1	ILD for BM and SF for simply supported and overhanging beam	Analysis of three hinged parabolic arches with supports at different levels	Derivation of flexibility coefficients using unit load method.	Apply SDM for drawing bending moment diagram (BMD) and shear force diagram (SFD) for propped cantilevers with and without overhang.	Analysis of continuous beams using direct stiffness method
	SLO-2	Finding maximum BM and SF using ILD for cantilever, simply supported and overhanging beam subject to moving point loads and udl – Introduction to IRC trailer load	Analysis of three hinged circular arches with supports at the same level	Determination of deflection of basic determinate beams using flexibility coefficients	Apply SDM for the analysis of beams up to a degree of static indeterminacy of 2 including the effect of support settlements.	Application of direct stiffness method for single storey portal frame
S-3	SLO-1	Tutorial class	Tutorial class	Tutorial class	Tutorial class	Tutorial class
	SLO-2					

S-4	SLO-1	*Concept of absolute maximum BM in simply supported beams*	*Derivation of horizontal reaction for two hinged parabolic arches including support movement, temperature change and rib shortening*	*Derivation of direct flexibility matrix equation.* *Solving propped cantilever using flexibility method.*	*Solving a rigid jointed plane frame with degree of static indeterminacy 2 using SDM*	*Introduction to element stiffness method- coordinate systems – element and global*
	SLO-2	*Finding absolute maximum BM and SF in a simply supported beam subjected to series of moving loads*	*Analyzing two hinged parabolic arches with a single point load*	*Formulation of flexibility matrix for a two span continuous beam with one of the end supports fixed*	*Introduction to moment distribution method (MDM) and definition of stiffness and carry over factors with a demonstrative analysis of a propped cantilever*	*Derivation of element stiffness matrix for truss, beam, frame elements in local coordinates*
S-5	SLO-1	*Finding absolute maximum BM /SF in a simply supported beam subjected to udl – shorter and longer than the span*	*Analyzing two hinged parabolic arches with udl occupying the entire span*	*Analyzing the two span continuous beam with one of the end supports fixed using direct flexibility method*	*Analysis of 2 span- continuous beams using MDM*	*Rotation matrix for truss element and transformation of element stiffness matrix in local coordinates to global coordinates*
	SLO-2	*ILD of propped cantilevers*	*Analyzing two hinged parabolic arches with part udl occupying anywhere in the span*	*Forming flexibility matrix for a single storey portal frame with a static indeterminacy of 2 with supports at the same level and analyzing*	*Analysis of 3 span- continuous beams using MDM including the effect of support settlements*	*Rotation matrix for frame element and transformation of element stiffness matrix in local coordinates to global coordinates*
S-6	SLO-1 SLO-2	*Tutorial class*	*Tutorial class*	*Tutorial class*	*Tutorial class*	*Tutorial class*
S-7	SLO-1	*ILD for two span continuous beam for end support reaction*	*Introduction to suspension cables*	*Forming flexibility matrix for a single storey portal frame with a static indeterminacy of 2 with supports at different levels and analyzing*	*Analysis of non sway frames using MDM*	*Computing load vector in global coordinates for truss problems.* *Assembling global stiffness matrix for truss problem*
	SLO-2	*ILD for two span continuous beam for mid support reaction*	*Analysis of suspension cables with udl – maximum and minimum cable tension and support reactions – resultant (Supports at same level)*	*Finding the support reactions for a single storey portal frame with a static indeterminacy of 3 with supports at same level and subjected to a lateral point load at beam level*	*Introduction to sway in portal frames*	*Computing joint load vector in beam/frame problems with uniformly distributed and point loads*
S-8	SLO-1	*ILD for two span continuous beam for mid support moment*	*Analysis of suspension cables with udl – maximum and minimum cable tension and support reactions – resultant (Supports at different levels)*	*Forming flexibility matrix for a single storey portal frame with a static indeterminacy of 3 with supports at same level and subjected to udl over the beam*	*Fixed end moments due to sway in single storey frames and analysis of single storey portal frames with sway using MDM*	*Assembling global stiffness matrix for two span continuous beams.* *Partitioning global stiffness matrix and finding the unknown displacements and reactions*
	SLO-2	*ILD for two span continuous beam for span BM and span shear*	*Finding the forces at anchor towers – saddle support with rollers and hinged supports* *Introduction to two hinged and three hinged stiffening girders*	*Finding the support reactions for a single storey portal frame with a static indeterminacy of 3 with supports at same and different levels and subjected to either udl over the beam or lateral load at beam level*	*KANI'S METHOD* *Introduction to Kani's method for multistory frames and definition of rotation factors and sway corrections*	*Assembling global stiffness matrix for single storey portal frame, partitioning, solving for unknown displacements and finding element forces from known displacements upto a static indeterminacy of 3*
S-9	SLO-1 SLO-2	*Tutorial class*	*Tutorial class*	*Tutorial class*	*Tutorial class*	*Tutorial class*

Learning Resources	1. *Menon D, Structural Analysis, Alpha Science International Limited, 2009* 2. *Pandit G.S., Gupta S.P., Structural Analysis- A Matrix Approach, 2nd ed., Tata McGraw-Hill, 2010* 3. *Punmia B.C., Ashok Kumar Jain, Arun Kumar Jain, Theory of Structures, 12th ed., Laxmi Publications, 2004* 4. *Hibbeler R.C., Structural Analysis, 8th ed., Prentice Hall, 2012*	5. *Bhavikatti S. S, Structural Analysis, Vol-1 &2, E-2, Vikas Publishing House Pvt Limited, 2009* 6. *Vaidyanathan R, Perumal. P, Comprehensive Structural Analysis-Volume I & II, Laxmi Publications (P) Ltd., 2004.* 7. *NPTEL Course: Structural Analysis – I. https://onlinecourses.nptel.ac.in/noc17_ce25/preview* 8. *NPTEL Course: Structural Analysis – II https://nptel.ac.in/downloads/105105109/*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-

	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Er. G.Hariharanath, GA Consultants, Chennai, gac1996@hotmail.com	*1. Dr. G. Appa Rao, Professor, IIT Madras, garao@iitm.ac.in*	*1. Dr. K.S. Satyanarayanan, SRMIST*
2. Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai, desigan.agv@gmail.com	*2. Dr. C. Uma Rani, Professor, Anna University, umarani@annauniv.edu*	*2. Prof. G. Augustine Maniraj Pandian, SRMIST*

Course Code	18CEC206L	Course Name	HYDRAULIC ENGINEERING LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize the Chezy's and Manning's equations			
CLR-2 :	Analyze the concept of hydraulic jump			
CLR-3 :	Utilize knowledge on notches and flumes			
CLR-4 :	Utilize knowledge in operating the currentmeter			
CLR-5 :	Utilize centrifugal pump, reciprocating pump, submersible pump and gear oil pump for suitable applications			
CLR-6 :	Utilize Pelton wheel turbine and Francis turbine for suitable applications			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Prof	Expected Attain	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Kn	Problem Anal	Design & Develop	Investigati	Modern Tool	Society & Cult	Environment	Ethics	Indivi	Communica	Project Mgt.	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Apply the concept of Chezy's and Manning's equations	3	90	85	H	M		-	-	-	-	-	H	-	-	-	H	-	H
CLO-2 :	Analyze hydraulic jump	3	90	85	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-3 :	Evaluate discharge using notches and flumes	3	90	85	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-4 :	Evaluate velocity usingcurrentmeter	3	90	85	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-5 :	Analyze the workingof centrifugal pump, reciprocating pump, submersible pump and gear oil pump	3	90	85	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-6 :	Analyze the workingof Pelton wheel turbine and Francis turbine	3	90	85	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H

Duration (hour)		6	6	6	6	6
S 1-2	SLO-1	Determine Chezy's constant for an open channel	Measure hydraulic jump	Determine coefficient of discharge for triangular notch	Test performance of centrifugal pump	Test performance of gear oil pump
	SLO-2					
S 3-4	SLO-1	Determine Manning's roughness coefficient for an open channel	Determine coefficient of discharge for rectangular notch	Measure velocity using current meter	Test performance of reciprocating pump	Test performance of Pelton wheel turbine
	SLO-2					
S 5-6	SLO-1	Determine specific energy curve	Measure flow using rectangular and triangular notches	Measure discharge using venturiflume	Test performance of submersible pump	Test performance of Francis turbine
	SLO-2					

Learning Resources	1. Modi, P.N., Seth S.M., Hydraulics and Fluid Machines, Standard book house, 2005 2. Subramanya, K., Theory and application of fluid mechanics, Tata McGraw Hill, 2002	3. Rajput R.K, Fluid Mechanics and Hydraulic Machines, S.Chand and Company Ltd.,2013 4. Laboratory Manual for Hydraulic Engineering Laboratory,SRMIST

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	40 %	-	30 %	-	30 %	-	30 %	-	30%
	Understand										
Level 2	Apply	-	40 %	-	40 %	-	40 %	-	40 %	-	40%

	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from Record and Model Examination.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Abdul Hakeem, National Remote Sensing Center, Hyderabad, abdulhakeem_k@nrsc.gov.in	*1. Dr. R. Saravanan, Anna University, rsaran@annauniv.edu*	*1. Dr. R. Sathyanathan, SRMIST*
2. Dr.Sat Kumar Tomer, Satyukt Analytics Pvt Ltd., Bengaluru, sat@satyukt.com	*2. Dr. S. Saravanan, NIT, Tiruchy, ssaravanan@nitt.edu*	*2. Mr. Shaik NiyazuddinGuntakal, SRMIST*

Course Code	18CEC206T	Course Name	HYDRAULIC ENGINEERING AND DESIGN	Course Category	C	Professional Core	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize dimensional and model analysis			
CLR-2 :	Address concepts related to open channel flow			
CLR-3 :	Utilize basic hydraulic concepts in measuring discharge and velocity in open channel			
CLR-4 :	Create insights into the components and functions of roto-dynamic pump			
CLR-5 :	Address concepts related to the components and functions of positive displacement pump			
CLR-6 :	Utilize the components, functions and uses of Pelton wheel, Kaplan and Francis turbines			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Prof	Expected Attain	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering K	Problem Anal	Design & Deve	Analysi	Modern Tool	Society & Cul	Environment	Ethics	Indiv	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify and solve various fluid problems involving dimensional and model analysis	3	80	70	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Analyze problems related to open channel flow	3	85	75	H	H	H	L	-	-	-	-	-	-	-	-	H	-	-
CLO-3 :	Identify various devices to measure and estimate discharge and velocity in open channel	3	85	75	H	M	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-4 :	Analyze the components and functions of rotodynamic pump	3	85	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-5 :	Identify the components and functions of positive displacement pump	3	85	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-6 :	Identify the components, functions and uses of various hydraulic turbines	3	80	70	H	H	H	L	-	-	-	-	-	-	-	-	H	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Dimensional and Model analysis***	***Open channel flow***	*Backwater computation by direct step method*	*Gauging flumes, non-modular/venturiflume*	*Air vessel and its functions*
	SLO-2	*Use of dimensional analysis, fundamental quantities and derived quantities*	*Comparison between open channel and pipe flows; Types of channels and types of flow in channels*	*Rapidly varied flow, hydraulic jump and its types*	*Standing wave / Modular flume*	*Working principle of hydraulic ram, jet pump and gear pump*
S-2	SLO-1	*M-L-T system for various quantities*	*Chezy's formula and Manning's formula*	*Expression for loss of energy due to jump, length of hydraulic jump, height of jump*	*Measurement of velocity, current meter*	***Turbines***
	SLO-2	*Dimensional homogeneity*	*Solving problems using tutorial sheet 4*	*Energy dissipaters and stilling basins*	*Floats, Hot-wire Anemometer*	*Components of hydroelectric power plant, classification of hydraulic turbines*
S-3	SLO-1	*Solving problems using tutorial sheet 1*	*Solving problems using tutorial sheet 4*	*Solving problems using tutorial sheet 7*	*Solving problems using tutorial sheet 10*	*Solving problems using tutorial sheet 13*
	SLO-2	*Solving problems using tutorial sheet 1*	*Design of most economical section of a channel*	*Solving problems using tutorial sheet 7*	*Solving problems using tutorial sheet 10*	*Solving problems using tutorial sheet 13*
S-4	SLO-1	*Rayleigh's method*	*Rectangular channel and trapezoidal channel*	***Measurement of discharge and velocity in open channel***	***Pumps***	*Pelton wheel, velocity triangles and work done*
	SLO-2	*Buckingham's π method*	*Non uniform flow through open channels*	*Flow over notches; Rectangular, triangular*	*Centrifugal pump, components and working*	*Design aspects of Pelton wheel*
S-5	SLO-1	*Selection of repeating variables; Application of dimensional analysis*	*Specific energy and specific energy curve*	*Trapezoidal and stepped notch*	*Velocity triangle, work done, losses and efficiencies*	*Francis turbine, velocity triangles and work done*
	SLO-2	*Model analysis*	*Critical depth, critical velocity*	*Types of Weirs*	*Specific speed, multistage centrifugal pump – pumps in parallel and series*	*Design aspects of Francis turbine*
S-6	SLO-1	*Solving problems using tutorial sheet 2*	*Solving problems using tutorial sheet 5*	*Solving problems using tutorial sheet 8*	*Solving problems using tutorial sheet 11*	*Solving problems using tutorial sheet 14*
	SLO-2	*Solving problems using tutorial sheet 2*	*Solving problems using tutorial sheet 5*	*Solving problems using tutorial sheet 8*	*Solving problems using tutorial sheet 11*	*Solving problems using tutorial sheet 14*
S-7	SLO-1	*Similitude – Geometric similarity*	*Minimum specific energy, critical flow; Subcritical flow and supercritical flow*	*Effect on discharge over a notch or weir due to error in the measurement of head*	*Characteristic curves, NPSH*	*Kaplan turbine, design aspects of Kaplan turbine*
	SLO-2	*Kinematic and dynamic similarity*	*Gradually varied flow*	*Velocity of approach and end contraction*	*Reciprocating pump, components and working*	*Draft tube, types*
S-8	SLO-1	*Dimensionless numbers and their significance*	*Characteristics of surface profiles*	*Cippoletti weir, broad crested weir*	*Coefficient of discharge, slip, indicator diagram*	*Specific speed and its significance*

	SLO-2	*Model (or similarity) laws; Model studies in fluid flow problems*	*Length of back water curve and afflux*	*Narrow crested weir, Ogee weir and drowned/submerged weir*	*Effect of acceleration and friction, Maximum speed of reciprocating pump*	*Characteristic curves of hydraulic turbines*
S-9	SLO-1	*Solving problems using tutorial sheet 3*	*Solving problems using tutorial sheet 6*	*Solving problems using tutorial sheet 9*	*Solving problems using tutorial sheet 12*	*Solving problems using tutorial sheet 15*
	SLO-2	*Solving problems using tutorial sheet 3*	*Solving problems using tutorial sheet 6*	*Solving problems using tutorial sheet 9*	*Solving problems using tutorial sheet 12*	*Solving problems using tutorial sheet 15*

Learning Resources	*1. Modi, P.N., Seth S.M., Hydraulics and Fluid Machines, Standard book house, 2005* *2. Subramanya, K., Theory and application of fluid mechanics, Tata McGraw Hill, 2002* *3. Rajput, R.K., Fluid Mechanics and Hydraulic Machines, S.Chand, 2014*	*4. Chandramouli P.N., Applied Hydraulic Engineering, Yesdee, 2017* *5. NPTEL Course-Hydraulics. https://nptel.ac.in/courses/105106114/#* *6. NPTEL Course-Fluid Machinery. https://nptel.ac.in/courses/112104117/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Abdul Hakeem, National Remote Sensing Center, Hyderabad, abdulhakeem_k@nrsc.gov.in	*1. Dr. R. Saravanan, Anna University, rsaran@annauniv.edu*	*1. Dr. R. Sathyanathan, SRMIST*
2. Dr. Sat Kumar Tomer, Satyukt Analytics Pvt Ltd., Bengaluru, sat@satyukt.com	*2. Dr. S. Saravanan, NIT, Tiruchy, ssaravanan@nitt.edu*	*2. Dr. DeepthaThattai, SRMIST*

Course Code	18CEC207T	Course Name	DESIGN OF RC AND STEEL STRUCTURES	Course Category	C	Professional Core	L	T	P	C
							4	0	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	IS 456 :2000, SP 16-Column Design Charts, IS 1905 :1987, IS 800: 2007, Steel Tables		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize the behavior of RC sections under flexure and shear and to get introduced to the design of brick masonry walls and relevant BIS codes			
CLR-2 :	Design RC using Limit state method			
CLR-3 :	Utilize the concepts in performing design of RC beams, slabs, columns and foundations			
CLR-4 :	Analyze behavior of Steel sections under tension, compression and flexure, identify relevant IS codes			
CLR-5 :	Design steel sections using Limit state method			
CLR-6 :	Utilize the concepts in performing design of steel tension, compression and flexural members and their connections			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Prof	Expected Attain	Program Learning Outcomes (PLO)														
					Engineering K	Problem A	Design & Dev	Analysi	Modern Tool	Society & Cul	Environment	Ethics	India	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify effect of external loads on brick masonry walls and RC members, factors influencing their behavior, identify relevant BIS codes	3	85	80	H	-	-	M	-	-	-	-	-	-	-	H	H	M	-
CLO-2 :	Analyze behavior of RC sections under flexure and shear	2	80	75	H	H	-	M	-	-	-	-	-	-	-	H	H	M	-
CLO-3 :	Apply Limit state method of design to RC beams, slabs, columns and foundations	2	85	80	H	H	H	H	-	-	-	-	-	-	-	H	H	M	-
CLO-4 :	Identify effect of external loads on Steel members, factors influencing their behavior, identify relevant BIS codes	3	85	80	H	-	-	M	-	-	-	-	-	-	-	H	H	M	-
CLO-5 :	Analyze the behavior of Steel sections under tension, compression and flexure	2	80	75	H	H	-	M	-	-	-	-	-	-	-	H	H	M	-
CLO-6 :	Apply Limit state method of design to steel tension, compression and flexural members and their connections	2	85	80	H	H	H	H	-	-	-	-	-	-	-	H	H	M	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	***INTRODUCTION TO MASONRY AND RC DESIGN*** *Introduction to brick masonry-Design of walls using BIS codes-Grade of concrete-concrete mix design-BIS code provisions-Design of nominal and design mix*	***RC SLABS*** *Reinforcement detailing of one way slabs*	***RC BEAMS*** *Concept of load transfer from slab to beam-Introduction to singly and doubly reinforced and flanged beams -Design recommendations as per IS 456:2000*	***RC STAIR-CASES*** *Design of dog-legged stair-case-Procedure*	***RC FOUNDATIONS*** *Introduction-Types of foundation-Transfer of forces at junction of column-foundation*
	SLO-2	*Basic design concepts- Design Philosophy-Working stress and Limit state method of design*	*Design of continuous slabs-Procedure*	*Design of singly reinforced beams-Procedure*	*Design of stair-cases-Example 1*	*Design recommendations as per IS 456:2000*
S-2	SLO-1	*RC DESIGN: Partial safety factors -Limit state method-advantages*	*RC SLABS Design of continuous slabs-Example 1*	*RC BEAMS Design of singly reinforced beams-Example 1*	*RC STAIR-CASES Design of stair-cases-Example 2*	*RC FOUNDATIONS Design of isolated foundation-axially loaded-sloped*
	SLO-2	*General design recommendations as per IS 456:2000*	*Design of continuous slabs-Example 2*	*Design of singly reinforced beams-Example 2*	*Reinforcement detailing-Use of SP 34*	*Design of isolated foundation-axially loaded-stepped*
S-3	SLO-1	***INTRODUCTION TO STEEL DESIGN AND PLASTIC ANALYSIS****: Types of steel structures - Properties of structural steel, Indian Standard Specifications and sections- Design criteria as per IS 800:2007-Analysis methods*	***STEEL TENSION MEMBERS*** *Design provisions of tension members*	***STEEL COMPRESSION MEMBERS*** *Design of simple columns-Procedure*	***STEEL CONNECTIONS*** *Design of pin connections*	*STEEL BEAMS Design provisions of beams*

	SLO-2	*Calculation of Loads as per IS codes-Design Philosophy-Introduction to Limit State Method of design – Partial safety factors- General design requirements as per IS800:2007*	*Design of simple tension members - Effective net area-Types of failures*	*Design of simple columns-Example 1*	*Design of lap joints-Procedure*	*Design of simple beams-restrained-Procedure*
S-4	SLO-1	*PLASTIC ANALYSIS :Plastic analysis, Plastic hinge mechanism, Plastic moment of resistance, Plastic modulus*	*STEEL TENSION MEMBERS Design of plates with holes subjected to tension-Procedure*	*STEEL COMPRESSION MEMBERS Design of simple columns-Example 2*	*STEEL CONNECTIONS Design of lap joints-Example 1*	***STEEL BEAMS** Design of simple beams-restrained-Example*
	SLO-2	*Shape Factor for rectangular, circular and triangular sections*	*Design of plates with holes subjected to tension-Example*	*Types of built up columns*	*Design of lap joints-Example 2*	*Lateral torsional buckling behaviour of unrestrained beams*
S-5	SLO-1	***RC DESIGN** :Behaviour of RC sections under flexure, stress blocks – IS, AC and BS*	***RC SLABS** Reinforcement detailing of continuous slabs*	***RC BEAMS** Design of doubly reinforced beams-Procedure*	***RC COLUMNS** Short and long columns, Effective length slenderness ratio, un braced and braced columns -Design recommendations as per IS 456:2000*	***RC FOUNDATIONS** Design of isolated foundation-eccentrically loaded-Procedure*
	SLO-2	*Behaviour of RC sections undershear*	*Design of two way slabs-Procedure*	*Design of doubly reinforced beams-Example 1*	*Design of axially loaded short columns*	*Design of isolated foundation-eccentrically loaded-Example*
S-6	SLO-1	*RC DESIGN :Design recommendations as per IS 456:2000-flexure*	*RC SLABS Design of two way slabs-Simply supported on the edges with corners not held down*	*RC BEAMS Design of doubly reinforced beams-Example 2*	*RC COLUMNS Uniaxial and biaxial bending of columns*	*RC FOUNDATIONS Design of combined rectangular foundation-Procedure*
	SLO-2	*Design recommendations as per IS 456:2000-shear*	*Design of two way slab- Simply supported on the edges with corners held down*	*Ductile detailing of beams as per IS 13920*	*Use of interaction curves from SP16*	*Design of combined rectangular foundation-Example*
S-7	SLO-1	***PLASTIC ANALYSIS**: Shape Factor for I section*	***STEEL TENSION MEMBERS** Design of angles subjected to tension-Procedure*	***STEEL COMPRESSION MEMBERS** Design of lacing-Procedure*	***STEEL CONNECTIONS** Design of butt joints-Procedure*	***STEEL BEAMS** Check for lateral torsional buckling of unrestrained beams-Steps*
	SLO-2	*Shape Factor for T and C sections*	*Design of angles subjected to tension-Example*	*Design of lacing-Example*	*Design of butt joints-Example 1*	*Check for lateral torsional buckling of unrestrained beams-Example*
S-8	SLO-1	*PLASTIC ANALYSIS: Load factor, Static method of plastic analysis*	*STEEL TENSION MEMBERS Design of built-up tension members-various cross-sections*	*STEEL COMPRESSION MEMBERS Design of batten-Procedure*	*STEEL CONNECTIONS Design of butt joints-Example 2*	*STEEL BEAMS Design of beams subjected to biaxial bending-Procedure*
	SLO-2	*Mechanism method of plastic analysis*	*Design of built-up tension members-Procedure*	*Design of batten-Example*	*Design of Truss joint-Procedure*	*Design of beams subjected to biaxial bending-Example 1*
S-9	SLO-1	***RC SLABS** Introduction-Types of slab -Introduction on moment co-efficient and design recommendations as per IS 456:2000*	***RC SLABS** Design of two way slabs-with edges fixed*	***RC BEAMS** Design of flanged beams-Procedure*	***RC COLUMNS** Design of long columns*	***RC FOUNDATIONS** Introduction to Strip Footing*
	SLO-2	*Design of one way slabs-Procedure*	*Design of two way slabs-Example*	*Design of flanged beams-design for torsion*	*Ductile detailing of columns as per IS 13920*	*Introduction to Raft Footing*
S-10	SLO-1	*RC SLABS Design of one way slabs-Example 1*	*RC SLABS Reinforcement detailing of two way slabs*	*RC BEAMS Design of flanged beams-Example 1*	*RC COLUMNS Reinforcement detailing at beam-column joints using SP34*	*RC FOUNDATIONS Design of pile foundation, pile cap*
	SLO-2	*Design of one way slabs-Example 2*	*Use of design handbooks*	*Design of flanged beams-Example 2*	*Extension of design of columns to piles*	*Reinforcement detailing*
S-11	SLO-1	***PLASTIC ANALYSIS** :Analysis of indeterminate beams with uniform M_p*	***STEEL TENSION MEMBERS** Design of built-up tension members-Example*	***STEEL CONNECTIONS** Types of connections-Bolted and welded*	***STEEL CONNECTIONS** Design of Truss joint-Example 1*	***STEEL BEAMS** Design of beams subjected to biaxial bending-Example 2*
	SLO-2	*Analysis of indeterminate beams with varying M_p*	*Tension splices*	*Types of bolts and welds-Permissible stresses*	*Design of Truss joint-Example 2*	*Design of built-up beams-Procedure*
S-12	SLO-1	*PLASTIC ANALYSIS :Analysis of single bay single storey rectangular portal frames-with same column heights*	***STEEL COMPRESSION MEMBERS** Design provisions of compression members*	*STEEL CONNECTIONS Load transfer mechanism*	***STEEL BEAMS** Behaviour of steel members in flexure*	*STEEL BEAMS Design of built-up beams-Example 1*

	SLO-2	*Analysis of single bay single storey rectangular portal frames with varying column heights*	*Effective length-Slenderness ratio-Types of buckling-Classification of cross-sections*	*Types of failure of connections*	*Phenomenon of web buckling and web crippling*	*Design of built-up beams-Example 2*

Learning Resources	1. *Varghese.P.C,Limit State Design of Reinforced Concrete,2nd ed.,, PHI Learning Pvt. Ltd.,2004* 2. *UnnikrishnaPillai.S, Devdas Menon, Reinforced Concrete Design, 5th ed., Tata McGraw, 2003* 3. *Subramanian.N, Design of Reinforced Concrete Structures, Oxford University Press, 2013* 4. *Punmia.B.C,Ashok Kumar Jain,Arun Kumar Jain,Limit State Design of Reinforced Concrete,1st edition, Laxmi Publications Pvt. Ltd.,2007* 5. *Subramanian.N, Design of Steel structures-Limit state method, Oxford University Press, 2016* 6. *Anand .S and Arya, "Masonry and Timber Structures Including Earthquake Resistant Design", Nem Chand and Brothers, Roorkee, 1987.*	7. *Duggal S.K, Limit state design of steel structures, Tata McGraw Hill,2010* 8. *Shah.V.L,, Veena Gore, Limit State Design of. Steel Structures, 1st ed.,Structures Publications, 2009* 9. *Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain,Comprehensive Design of Steel structures, Laxmi Publications Pvt. Ltd.,2007.* 10. *NPTEL Course:: Design of Reinforced Concrete Structures https://onlinecourses.nptel.ac.in/noc18_ce24/preview* 11. *NPTEL Course:: Design of Steel Structures https://onlinecourses.nptel.ac.in/noc17_ce21/preview*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Er. G.Hariharanath, GA Consultants, Chennai, gac1996@hotmail.com	*1. Dr. G. Appa Rao, Professor, IIT Madras, garao@iitm.ac.in*	*1.Prof. G. Augustine Maniraj Pandian, SRMIST*
2. Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai,desigan.agv@gmail.com	*2. Dr. C. Uma Rani, Professor, Anna University, umarani@annauniv.edu*	*2.Dr.N.Umamaheswari, SRMIST*

Course Code	18CEC208L	Course Name	ENVIRONMENTAL ENGINEERING LABORATORY	Course Category	C	Professional Core	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Evaluate characteristics of water			
CLR-2 :	Evaluate the characteristics of waste water			
CLR-3 :	Conduct tests on water and wastewater			
CLR-4 :	Utilize turbidity meter, pH meter, electrical conductivity meter			
CLR-5 :	Utilize spectrophotometer, high volume sampler, noise level meter			
CLR-6 :	Conduct titration experiments			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Pro	Expected Attain	Program Learning Outcomes (PLO)														
					Engineering K		Analysis	Design & Deve	Investigati	Modern Tool	Society & Cult	Environment	Ethics	Indivi	Communica	Project Mgt.	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Evaluate the characteristics of water	3	90	85	H	M	-	-	-	-	H	-	-	-	-	-	H	-	H
CLO-2 :	Analyze the characteristics of waste water	3	85	80	H	M	-	-	-	-	H	-	-	-	-	-	H	-	H
CLO-3 :	Test water and wastewater sample	3	90	85	H	M	-	-	-	-	-	-	-	-	-	-	H	-	H
CLO-4 :	Identify the working of turbidity meter, pHmeter, electrical conductivity meter	3	85	80	H	M	-	-	-	-	-	-	-	-	-	-	H	-	H
CLO-5 :	Identify the working of spectrophotometer, high volume sampler, noise level meter	3	85	80	H	M	-	-	-	-	H	-	-	-	-	-	H	-	H
CLO-6 :	Conduct titration based experiments	3	85	80	H	M	-	-	-	-	H	-	-	-	-	-	H	-	H

Duration (hour)		6	6	6	6	6
S 1-2	SLO-1	Determine turbidity, electrical conductivity, pH	Determine solids contents in water: Total, volatile, fixed, suspended, dissolved, settle able and inorganic solids	Determine alkalinity and Acidity	Determine total hardness, calcium and magnesium hardness	Determine chloride and sulphate
	SLO-2					
S 3-4	SLO-1	Determine optimum coagulant dose	DetermineChemical Oxygen Demand (COD)	Determine Dissolved Oxygen(DO) and Biological Oxygen Demand(BOD)	Determine break point chlorination	Determine copper
	SLO-2					
S 5-6	SLO-1	Determine bacteriological quality measurement: MPN	Monitor Ambient air quality (TSP,RSPM)	Monitor Ambient air quality (So_x)	Monitor Ambient air quality (NO_x)	Measure Ambient noise
	SLO-2					

Learning Resources	1. S. K. Garg, Water Supply Engineering, Khanna Publishers, 2017 2. S. K. Garg, Sewage Disposal and Air Pollution Engineering, Khanna Publishers, 2017	3. IS:10500-2012, Indian Standards for Drinking Water, Bureau of Indian Standards, New Delhi. 4. Environmental Engineering lab manual, SRMIST

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	40 %	-	30 %	-	30 %	-	30 %	-	30%

	Understand										
Level 2	Apply	-	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*
	Analyze										
Level 3	Evaluate	-	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from Record and Model Examination.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Rajkumar Samuel, Hubert Enviro-Care Systems, Chennai, rajkumar@hecs.in	*1. Dr. S. Madhava Kumar, IIT Madras, mathav@iitm.ac.in*	*1. Mrs. Sija Arun, SRMIST*
2. Mr. A. Abdul Rasheed, CMWSS Board, juruterarasheed@gmail.com	*2. Dr .G. Dhinagaran, Anna University, Chennai, dhinagaran@annauniv.edu*	*2. Mr.S.Ramesh, SRMIST*

Course Code	18CEC208T	Course Name	ENVIRONMENTAL ENGINEERING AND DESIGN	Course Category	C	Professional Core	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Utilize the sources of water supply and its quality
CLR-2 :	Design and Construct water treatment for domestic supplies
CLR-3 :	Utilize sanitary engineering concepts for implementation
CLR-4 :	Design sewage treatment plants for towns and cities
CLR-5 :	Utilize solid waste management mechanisms
CLR-6 :	Analyze the role of Government and NGO's in sustaining the environment

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		Level	Expected Prof	Expected Attain	Engineering Kn	Problem Anal	Design & Dev	Analysi	Modern Tool	Society & Cult	Environment	Ethics	Indiv	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Identify the various sources of water and its quality	2	85	80	H	H	M	L	-	L	H	-	-	-	-	L	H	-	-
CLO-2 :	Design water treatment units for domestic purposes	3	85	75	H	H	H	H	-	-	H	-	-	-	-	-	H	-	-
CLO-3 :	Identify the collection and conveyance of domestic sewage	2	80	75	H	H	M	M	-	L	H	-	-	-	-	L	H	-	-
CLO-4 :	Design of sewage treatment units for sanitary sewage	3	85	75	H	H	H	H	-	-	H	-	-	-	-	-	H	-	-
CLO-5 :	Apply the concept of reducing, reuse, recycling in solid waste management	2	85	80	H	H	M	M	L	L	M	-	-	-	-	L	H	-	-
CLO-6 :	Analyze the environmental legislations	2	80	75	H	H	M	-	-	L	M	M	-	-	-	-	H	-	-

		Water Supply	Water Treatment	Sanitary Engineering	Disposal of Sewage	Solid Waste Management & Air Pollution
Duration (hour)		9	9	9	9	9
S-1	SLO-1	Water quality requirement for different beneficial uses	Concept and objectives of water treatment	Domestic and storm water quantity of sewage and flow variations	Concept of sewage disposal	Concept and generation of solid waste
	SLO-2	Importance of water supply scheme and Need for protected water supply	Principles of Aeration and Sedimentation. Types of sedimentation & design	Conveyance of sewage and types of sewers. Design of sewers	Pollution due to improper disposal of sewage	Municipal Solid Waste(MSW), composition and other parameters
S-2	SLO-1	Various sources of water available for supply	Principles of Coagulation and Flocculation	Pumping of sewage and sewer appurtenances	Zones of pollution and Self-purification of rivers	Quantification and Collection of MSW
	SLO-2	Per capita consumption-Demand	Types of coagulants used in water treatment	Laying and jointing of sewer lines	Oxygen sag curve. National river cleaning plans Dissolved Oxygen and BOD	Treatment and disposal of MSW
S-3	SLO-1	Solving problems using Tutorial Sheet 1	Solving problems using Tutorial Sheet 4	Solving problems using Tutorial Sheet 7	Solving problems using Tutorial Sheet 10	Solving problems using Tutorial Sheet 13
	SLO-2	Solving problems using Tutorial Sheet 1	Solving problems using Tutorial Sheet 4	Solving problems using Tutorial Sheet 7	Solving problems using Tutorial Sheet 10	Solving problems using Tutorial Sheet 13
S-4	SLO-1	Quality issues in various sources of water	Concept and theory of Filtration	Different plumbing systems adopted in buildings	Disposal of treated sewage in irrigation land	Waste from commercial establishments and other urban areas
	SLO-2	Water Pollution, sources, causes and effects. Water quality characteristics	Working principles of slow sand filters and design	Sanitary fittings used in buildings. Quantification of storm water	Sewage sickness and remedial measures	Effect of solid waste on environment
S-5	SLO-1	WHO and BIS standards and Water Borne Diseases	Working principles of rapid sand filters and design	Concept of Primary, Secondary and Tertiary treatments	Concept of sludge management	Segregation and disposal methods of sloid waste

	SLO-2	*Population forecast using different methods*	*Disinfection of water and Chlorination*	*Screening and Grit Chambers*	*Thickening, Conditioning and Dewatering of sludge*	*Reduction at source, recovery and recycle*
S-6	SLO-1	*Solving problems using Tutorial Sheet 2*	*Solving problems using Tutorial Sheet 5*	*Solving problems using Tutorial Sheet 8*	*Solving problems using Tutorial Sheet 11*	*Solving problems using Tutorial Sheet 14*
	SLO-2	*Solving problems using Tutorial Sheet 2*	*Solving problems using Tutorial Sheet 5*	*Solving problems using Tutorial Sheet 8*	*Solving problems using Tutorial Sheet 11*	*Solving problems using Tutorial Sheet 14*
S-7	SLO-1	*Water requirements for industrial need and agriculture*	*Advanced treatment like adsorption, ion exchange*	*Concept of aerobic and anaerobic treatment systems*	*Various disposal methods of sludge*	*Concept of Air Pollution: Properties and monitoring of Air pollutants*
	SLO-2	*Components of water supply system*	*Advanced treatment like membrane processes and UV methods.*	*Primary settling tanks and secondary settling tanks*	*Energy recovered from sludge*	*Air quality standards and control measures for Air Pollution*
S-8	SLO-1	*Transmission of water and distribution system*	*Effective water management Rain water harvesting methods*	*Principles of septic tanks and design.*	*Revenue from end product of sludge management*	*Basic concept of Noise Pollution and measurements*
	SLO-2	*Service reservoirs used in water supply*	*Measures taken for protecting the existing water bodies*	*Activated Sludge Process and Trickling Filters*	*Design of Sludge digestion tanks*	*Various control methods of noise pollution Acceptable standards for Noise levels*
S-9	SLO-1	*Solving problems using Tutorial Sheet 3*	*Solving problems using Tutorial Sheet 6*	*Solving problems using Tutorial Sheet 9*	*Solving problems using Tutorial Sheet 12*	*Solving problems using Tutorial Sheet 15*
	SLO-2	*Solving problems using Tutorial Sheet 3*	*Solving problems using Tutorial Sheet 6*	*Solving problems using Tutorial Sheet 9*	*Solving problems using Tutorial Sheet 12*	*Solving problems using Tutorial Sheet 15*

Learning Resources	*1.Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, Tata McGraw Hill, New Delhi 2005* *2. S.K.Garg, Water Supply Engineering, Khanna Publishers, NewDelhi, 2017* *3. S.K.Garg, Sewage Disposal and Air Pollution Engineering,, Khanna Publishers, NewDelhi, 2017* *4. 4. CPHEEO Manual on Water Supply and Treatment, Ministry of Drinking water and Sanitation, New Delhi, 2015*	*5. George Tchobanoglous, Hilary Theisen and Samuel Vigil, Integrated Solid Waste Management, McGraw Hill, Singapore, 1993.* *6. CPHEEO Manual on Sewerage and Sewage Treatment, Ministry of Urban Development, New Delhi, 2010* *7. NPTEL Course-Water, Society & Sustainability. https://onlinecourses.nptel.ac.in/noc18_hs36/* *8. NPTEL Course-Wastewater Treatment & Recycling* https://onlinecourses.nptel.ac.in/noc18_ce26

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Rajkumar Samuel, Hubert Enviro-Care Systems, Chennai, rajkumar@hecs.in	*1. Dr. S. Madhava Kumar, IIT Madras, mathav@iitm.ac.in*	*1. Mr. K. Prasanna, SRMSIT*
2. Mr. A. Abdul Rasheed, CMWSS Board, juruterarasheed@gmail.com	*2. Dr. G. Dhinagaran, Anna University, Chennai, dhinagaran@annauniv.edu*	*2. Mr. D. Justus Reymond, SRMIST*

Course Code	18CEC301T	Course Name	HYDROLOGY AND WATER RESOURCES ENGINEERING	Course Category	C	Professional Core Course	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	18CEE311T, 18CEE312T, 18CEE313T
Course Offering Department	CIVIL ENGINEERING			Data Book / Codes/Standards	Nil

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Provide knowledge on various processes in the hydrologic cycle			
CLR-2 :	Address the occurrence, movement and augmentation of groundwater			
CLR-3 :	Provide deep understanding of various impounding and diversion structures			
CLR-4 :	Create insights on the importance and characteristics of rivers and reservoirs			
CLR-5 :	Address concepts related to necessity of irrigation, methods of applying water to the fields and evapotranspiration			
CLR-6 :	Introduce various hydraulic structures and exploit their practical importance			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level to	Expected Profic	Expected Attain	Program Learning Outcomes (PLO)														
					1 Engineering Kno	2 Problem Analy	3 Design & Develo	4 Analysis	5 Modern Tool	6 Society & Culture	7 Environment	8 Ethics	9 Individual & Tea	10 Communica	11 Project Mgt.	12 Life Long L	13 PSO-1	14 PSO-2	15 PSO-3
CLO-1 :	Understand the interaction among various processes in the hydrologic cycle	2	85	80	H	H	M	M	-	-	M	-	-	-	-	-	H	-	-
CLO-2 :	Intellectualize the basic aquifer parameters and estimate groundwater resources for different hydro-geological boundary conditions	3	85	75	H	H	-	-	-	-	M	-	-	-	-	-	H	-	-
CLO-3 :	Understand the importance, features and uses of diversion and impounding structures	3	80	75	H	-	-	-	-	-	M	-	-	-	-	-	H	-	-
CLO-4 :	Perceive the importance of rivers, reservoirs and silt control	2	85	80	H	-	-	-	-	-	M	-	-	-	-	-	H	-	-
CLO-5 :	Understand the basics of irrigation, soil-water relationships and consumptive use	2	85	75	H	H	M	M	-	-	M	-	-	-	-	-	H	-	-
CLO-6 :	Identify the functions and importance of various hydraulic structures	3	80	75	H	H	-	-	-	-	M	-	-	-	-	-	H	-	-

		SURFACE WATER HYDROLOGY	GROUND WATER HYDROLOGY	DIVERSION AND IMPOUNDING STRUCTURES	RIVERS AND RESERVOIRS	IRRIGATION AND DISTRIBUTION SYSTEMS
Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction, hydrologic cycle	Occurrence of ground water, porosity	Weirs and barrages	Rivers: types and characteristics	Irrigation, necessity, advantages and disadvantages
	SLO-2	World water balance, applications in engineering	Permeability and transmissibility	Gravity and non-gravity weirs	Classification based on the basis of the topography of the river basin	Methods of applying water to the fields
S-2	SLO-1	Precipitation, forms and types	Zones of subsurface water	Diversion head works and its components	Classification based on the basis of flood hydrographs	Surface, subsurface, sprinkler and drip irrigation
	SLO-2	Measurement of precipitation, rain gauge network	Movement of groundwater, Darcy's law	Functions of weir proper, under sluices, divide wall, fish ladder and canal head regulator	Indian rivers and their classification	Soil-water-plant relationship
S-3	SLO-1	Mean areal depth of precipitation, arithmetic average method	Specific yield and specific retention	Failure of hydraulic structures	Behaviour of rivers: straight reaches, bends and meanders	Hygroscopic water, capillary water and gravitational water
	SLO-2	Thiessen polygon method and isohyetal method	Aquifers and their types	Failure by piping and failure by direct uplift	Causes of meandering, cutoff	Field capacity, permanent wilting point, available moisture, readily available moisture
S-4	SLO-1	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
	SLO-2	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
S-5	SLO-1	Estimation of missing precipitation	Specific capacity and coefficient of storage	Bligh's creep theory	River training: objectives and classification	Depth of water stored in root zone
	SLO-2	Optimum raingauge network design	Infiltration wells and infiltration galleries	Lane's weighted creep theory	Types of training works	Limiting soil moisture conditions, depth and frequency of irrigation
S-6	SLO-1	Probable Maximum Precipitation	Open wells and tube wells	Khosla's theory	Levees, guide banks	Crop season, duty and delta

	SLO-2	*Runoff process, components of stream flow*	*Types of tube wells*	*Khosla's method of independent variables for determination of pressures and exit gradient for seepage below a weir or a barrage*	*Artificial cutoff and pitched island*	*Factors affecting duty and method of improving duty*
S-7	SLO-1	*Factors affecting runoff*	*Yield of an open well, pumping test*	*Design of pucca floor and aprons*	*Groynes: types – normal, attracting and deflecting*	*Consumptive use: estimation by Blaney Criddle method and pan evaporation method*
	SLO-2	*Estimation of runoff, empirical formulae*	*Recuperation test*	*Design of pucca floor and aprons*	*Reservoir: types*	*Canal: types of alignment*
S-8	SLO-1	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*
	SLO-2	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*
S-9	SLO-1	*Infiltration method*	*Steady state flow in wells*	*Dams, function and uses, classification*	*Suitable site for a reservoir and storage zones*	*Distribution systems, channel losses*
	SLO-2	*SCS-CN method of estimating runoff volume*	*Dupuit's equilibrium equation for confined and unconfined aquifers*	*Factors governing the selection of a particular type of dam*	*Storage-discharge relation of a reservoir*	*Design of channels: rigid boundary channels and alluvial channels*
S-10	SLO-1	*Flow duration curve*	*Theim's equation for confined aquifer*	*Selection of dam site, problems in dam construction*	*Reservoir yield, safe yield, design yield, secondary yield and average yield*	*Kennedy's and Lacey's theories of regime channels*
	SLO-2	*Flow mass curve*	*Theim's equation for unconfined aquifer*	*Gravity dams: forces on gravity dams*	*Mass curve and demand curve*	*Water logging: causes, effects and remedial measures*
S-11	SLO-1	*Hydrograph, components of hydrograph*	*Spacing of wells*	*Modes of failure, construction of gravity dams*	*Designing reservoir capacity for a given yield and designing yield from a reservoir of a given capacity*	*Functions and uses of canal regulator and cross regulator*
	SLO-2	*Environmental flows*	*Artificial recharge methods*	*Galleries: functions and types.* *Earthen dam: types and causes of failure*	*Reservoir sedimentation: pre and post control measures, economic height of dam*	*Functions and uses of canal fall, canal escape and cross drainage works*
S -12	SLO-1	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*
	SLO-2	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*

Learning Resources	1. *Santosh Kumar Garg, Irrigation Engineering and Hydraulic Structures, Khanna Publication, New Delhi, 2000.* 2. *Subramanya, K., Engineering Hydrology, Tata Mc-Graw Hill* 3. *Asawa, G.L.., Irrigation Engineering, Wiley Eastern* 4. *Ven Te Chow, David R. Maidment and Larry W. Mays, Applied Hydrology, McGraw-Hill* Book Company	*5. Raghunath, H.M., Hydrology, New Age International Publishers, New Delhi, 2007.* *6. Sharma, R.K., Irrigation Engineering and Hydraulic Structures, Oxford and IBH Publishing Company, New Delhi* *7. Punmia, B.C., and Pande, B.B., Irrigation and Water Power Engineering, Laxmi Publications Pvt. Ltd., New Delhi, 2009* *8..NPTEL Course: Water Resources Engineering: https://nptel.ac.in/downloads/105105110/#,*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Abdul Hakeem, National Remote Sensing Center, Hyderabad, abdulhakeem_k@nrsc.gov.in	*1. Dr. Rehana Shaik, IIIT, Hyderabad, rehana.s@iiit.ac.in*	*1. Dr. R. Sathyanathan, SRMIST*
2. Dr. Sat Kumar Tomer, Satyukt Analytics Pvt Ltd., Bengaluru, sat@satyukt.com	*2. Dr. S. Saravanan, NIT Trichy, saravanans@nitt.edu*	*2. Dr. Deeptha Thattai, SRMIST*

Course Code	18CEC302L	Course Name	GEOTECHNICAL ENGINEERING LABORATORY	Course Category	C	Professional Core Course	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): The purpose of learning this course is to:

		Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Determine the engineering and index properties of soils																		
CLR-2 :	Determine the compaction and CBR value of soil																		
CLR-3 :	Impart knowledge on permeability characteristics of soil																		
CLR-4 :	Determine the filed density of soil																		
CLR-5 :	Determine the shear strength of soil																		
CLR-6 :	Study the working principle and function of triaxial shear test																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of	Expected Per	Expected Attai	Engineering K	Problem Anal	Design & Deve	Conduct Inve	Modern Tool U	Society & Cul	Environment &	Ethics	Individ	Communica	Project Mgt. & Fi	Life Long	PSO – 1	PSO – 2	PSO – 3
CLO-1 :	Identify the use of sieve, Atterberg's apparatus in determination of soil properties.	2	90	85	H	H	-	-	-	-	-	-	H	-	-	-	M	-	H
CLO-2 :	Estimate the OMC and Density to compact and CBR value of soil	2	85	80	H	H	-	-	-	-	-	-	H	-	-	-	M	-	H
CLO-3 :	Analyse the permeability characteristics of various soil.	2	90	85	H	H	-	-	-	-	-	-	H	-	-	-	M	-	H
CLO-4 :	Measure the density of soil in-situ	2	85	80	H	H	-	-	-	-	-	-	H	-	-	-	M	-	H
CLO-5 :	Evalute the shear strength of soil	2	85	80	H	H	-	-	-	-	-	-	H	-	-	-	M	-	H
CLO-6 :	Understand the working principle and use of triaxial shear test	2	85	80	H	H	-	-	-	-	-	-	H	-	-	-	M	-	H

Duration (hour)		6	6	6	6	6
S 1-2	SLO-1	Moisture content using oven drying method	Consistency limits - Liquid limit, Plastic limit and Shrinkage limit.	Compaction test - Standard Proctor method	California Bearing Ratio of soil	Direct shear test
	SLO-2					
S 3-4	SLO-1	Specific gravity of soil grains	Permeability - Constant head method.	Field density - Core cutter method and Sand replacement method	Unconfined compression strength test	Triaxial shear test
	SLO-2					
S 5-6	SLO-1	Grain size distribution by sieve analysis	Permeability - Falling head method	Relative density of cohesion less soil	Free swell index test	Vane shear test
	SLO-2					

Learning Resources

1. Raju .K.V.B .and Ravichandran .P.T, "Mechanics of Soils", Ayyappaa Publications, 2000.
2. Punmia B.C., Soil Mechanics and Foundations, Laxmi Publications Pvt. Ltd., 2000
3. Laboratory Manual for Soil Mechanics Laboratory, SRMIST
4. Terzaghi K., Peck R.B., Soil Mechanics in Engineering Practice, John Wiley Ltd., 1967
5. NPTEL course – Geotechnical Engineering Laboratory : https://nptel.ac.in/courses/105101160/

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	-	40%	-	30%	-	30%	-	30%	-	30%
Level 2	Apply / Analyze	-	40%	-	40%	-	40%	-	40%	-	40%
Level 3	Evaluate	-	20%	-	30%	-	30%	-	30%	-	30%

	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from Record and Model Examination.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. P.Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com	*Dr.M.Muttharam, Anna University, muttharam@annauniv.edu*	*Ms.S. Mary Rebekah Sharmila, SRMIST.*
Mr.Lenin K.R., Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in	*Dr.V.Murugaiyan, Pondichery Engineering College, vmurugaiyan@pec.edu*	*Ms.Divya Krishnan K, SRMIST*

Course Code	18CEC302T	Course Name	GEOTECHNICAL ENGINEERING	Course Category	C	Professional Core Courses	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Create insights in to different properties of soil
CLR-2 :	Deal with the classification and identification of soil
CLR-3 :	Understand concept of permeability and seepage of soils
CLR-4 :	Analyse the consolidation and compaction effect on soil in lab and field
CLR-5 :	Analyse the principles of effective stress in saturated soils, various soil condition the shear strength of the soils
CLR-6 :	Utilize the concept of various soil condition and shear strength of the soils in real time applications

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of	Expected Profi	Expected Attai	Engineering Kn	Problem Analys	Design & Develo	Conduct Investi	Modern Tool Us	Society & Cultu	Environment &	Ethics	Individual & Tea	Communica	Project Mgt. & F	Life Long	PSO-1	PSO-2	PSO-3
CLO-1 :	Identify the various properties of soil	2	85	80	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Analyse the classification of soil	2	85	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-3 :	Identify permeability and seepage of soils	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-4 :	Identify the consolidation and compaction effect on soil in lab and field	2	85	80	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-5 :	Apply the principles of effective stress in saturated soils, various soil condition the shear strength of the soils	2	85	80	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-6 :	Analyse the concept of various soil condition and shear strength of the soils in real time applications	2	80	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-

Duration (hour)		09	09	09	09	09
S-1	SLO-1	*Introduction-Definitions: soils*	*Particle size distribution*	*Permeability of Soil-importance*	*Compaction of Soil*	*Introduction- Stresses in soils*
	SLO-2	*Soil mechanics*	*Sieve analysis - problem*	*Introduction to hydraulic head*	*Introduction, theory of compaction,*	*Geostatic stress*
S-2	SLO-1	*Scope of Geotechnical engineering,*	*Plasticity Characteristics of soil*	*Darcy's law - Assumptions.*	*Laboratory determination of optimum moisture content and maximum dry density*	*Total - Effective and Neutral stress,*
	SLO-2	*Basic Definitions and Relationships-*	*Introduction to definitions of: plasticity of soil*	*Determination of coefficient of permeability*	*Standard Proctor test and Modified Proctor test – Problems in compaction*	*Fluctuations of effective stress*
S-3	SLO-1	*Two and three phase system of soil*	*Consistency limits-liquid limit, plastic limit*	*Laboratory method: Constant head method problems*	*Compactive energy –Factors affecting compaction*	*Effective stress in soils saturated by capillary action,*
	SLO-2	*Relationships in terms of weightand volume in phase system – moisture content*	*Shrinkage limit, Determination of: liquid limit*	*Coefficient of permeability*	*CBR of soil – procedure - problem*	*Problems in Geostatic stress – soil condition*
S-4	SLO-1	*Definitions: degree of saturation, void ratio, porosity*	*Determination of plastic limit and shrinkage limit.*	*Falling head method - problems*	*Field compaction methods*	*Problems in Geostatic stress – water table effect*
	SLO-2	*specific gravity, unit weights*	*Indices: Plasticity, liquidity and consistency, flow and toughness*	*Field method: types*	*Factors affecting field compaction*	*Shear Strength- Lab and filed methods*
S-5	SLO-1	*Relationship between bulk and dry density , void ratio- porosity, void ratio*	*Definition: Activity and sensitivity.*	*Pumping-out test – Confined aquifer*	*Consolidation of Soil*	*Shear test: direct shear test*
	SLO-2	*Water content- specific gravity-degree of saturation*	*Classification of Soils*	*Field method - Unconfined aquifer*	*Introduction, comparison between compaction and consolidation,*	*Shear test: merits and demerits - problem*

S6	SLO-1	*Unit weights - specific gravity - void ratio – degree of saturation –*	*Introduction of soil classification system*	*problems in field methods*	*Initial, primary consolidation*	*Unconfined compression test - problem*
	SLO-2	*Moisture content determination – Methods, Determination by oven dry method*	*methods:- particle size classification*	*Permeability in stratified soils*	*Secondary consolidation*	*Triaxial compression tests.*
S-7	SLO-1	*Problems in two phase system.*	*Indian standard soil classification system*	*Flow parallel and perpendicular to bedding plane - problems*	*Spring analogy for primary consolidation,*	*Drainage conditions*
	SLO-2	*Problems in three phase system.*	*Indian Soil classification system cohesive soil, cohesionless soil.*	*Factors affecting permeability of soil*	*Terzaghi's theory of one dimensional consolidation*	*Merits and demerits*
S-8	SLO-1	*Specific gravity – methods,*	*Indian Soil classification system –- Problems*	*Quick sand condition - Seepage Analysis*	*Partial differential equations (no analytical)*	*Drainage conditions- problem*
	SLO-2	*Determination by density bottle method and pycnometer method*	*Problems in BIS system*	*Introduction- seepage pressure.*	*Laboratory tests-*	*Relation between major and minor principal stresses*
S-9	SLO-1	*Field density methods – Determination by core cutter method*	*Soil identification*	*Characteristics of flow nets*	*Determination of coefficient of consolidation*	*Vane shear test. – problem*
	SLO-2	*Sand replacement method.*	*Field identification of soils.*	*Uses and application of flow nets.*	*√t andLog t methods.*	*Factors affecting shear strength*

Learning Resources	*5. Raju .K.V.B .and Ravichandran .P.T, "Mechanics of Soils", Ayyappaa Publications, 2000.* *6. Punmia B.C., Soil Mechanics and Foundations, Laxmi Publications Pvt. Ltd., 2000* *7. Arora .K.R, "Soil Mechanics and Foundation Engineering", Standard Publication Distributors, 2011.* *8. Gopal Ranjan, Rao.A.S.R., Basic and Applied Soil Mechanics, Wiley Eastern Ltd., 2000*	*5. Terzaghi K., Peck R.B., Soil Mechanics in Engineering Practice, John Wiley Ltd., 1967* 6. *Lambe T.W., Whitman, Soil Mechanics, John Wiley Ltd., 1979.* 7. NPTEL Course - Soil Mechanics / Geotechnical Engineering1 : https://nptel.ac.in/courses/105105168/ *8.* NPTEL Course - Concepts in Geotechnical and Foundation Engineering : *https://nptel.ac.in/courses/105106142/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*30%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	30%	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 : Assignments and / or Multiple choice Quizzes

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. P.Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com	*Dr.M.Muttharam, Anna University, muttharam@annauniv.edu*	*Dr. P.T. Ravichandran, SRMIST*
Mr.Lenin K.R., Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in	*Dr.V.Murugaiyan, Pondichery Engineering College, vmurugaiyan@pec.edu*	*Ms.Divya Krishnan K, SRMIST*

Course Code	18CEC303L	Course Name	HIGHWAY ENGINEERING LABORATORY	Course Category	C	Professional Core Course	L	T	P	C
							0	0	2	1

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Learn the methodology used to measure traffic volume count and categorize different mode of traffic at straight road and intersection			
CLR-2 :	Analyze the travel time and speed characteristics			
CLR-3 :	Study the parking characteristics			
CLR-4 :	Measure the properties of bitumen and aggregates			
CLR-5 :	Learn the proportioning of aggregate			
CLR-6 :	Measure the volumetric and strength of bituminous mixture			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Pro	Expected Attain	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering K	Problem Ana	Design & Deve	Analysi	Modern Tool	Society & Cul	Environment	Ethics	Indiv	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Evaluate the vehicular composition in the straight road and intersection	3	90	85	H	M		-	-	-	-	-	H	-	-	-	H	-	H
CLO-2 :	Understand the travel time, delay and speed characteristics	3	85	80	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-3 :	Apply the effective parking systems	3	90	85	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-4 :	Grade the bitumen and select the aggregate for the preparation of bituminous mixture	3	85	80	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-5 :	Design the aggregate gradation for bituminous mixture	3	85	80	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H
CLO-6 :	Design the bituminous mixture mix proportion	3	85	80	H	M	-	-	-	-	-	-	H	-	-	-	H	-	H

Duration (hour)		6	6	6	6	6
S 1-2	SLO-1	Determination of Vehicular composition in Straight moving traffic stream	Determination of traffic stream parameters by Moving Observer method	Determination of the penetration value of bitumen	Determination of ductility of bitumen	Batching of aggregates
	SLO-2					
S 3-4	SLO-1	Determination of Vehicular turning movement at any intersection	Evaluation of on street parking characteristics	Determination of softening point of bitumen	Determination of specific gravity of bitumen and aggregates	Preparation of bituminous mix and measure of mixture volumetric properties
	SLO-2					
S 5-6	SLO-1	Determination of instantaneous spot speed of vehicles	Evaluation of off street parking characteristics	Determination of viscosity of bitumen	Performance grading of bitumen - demo	Marshall stability test and design of bituminous mix
	SLO-2					

Learning Resources	1. S. K Khanna, C E G Justo, A Veeraraghavan, Highway Engineering,Nem Chand and Bros 2. IS 73 : 2013, Paving Bitumen - Specification, 4th Revision, BIS, New Delhi	3. IS 15462:2004, Polymer and Rubber Modified Bitumen - Specification, BIS, New Delhi 4. MoRTH. Specification for roads and bridge work. Indian Roads Congress, New Delhi, India.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	40 %	-	30 %	-	30 %	-	30 %	-	30%
	Understand										
Level 2	Apply	-	40 %	-	40 %	-	40 %	-	40 %	-	40%
	Analyze										
Level 3	Evaluate	-	20 %	-	30 %	-	30 %	-	30 %	-	30%
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from Record and Model Examination.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com	*Dr. VenkaiahChowdary, Associate Professor, NITW, vc@nitw.ac.in*	*Dr. A. Padma Rekha, SRM IST*
Mr. Ankit Pachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org	*Dr. V Sunitha, Assistant Professor, NITT, sunitha@nitt.edu*	*Mr. G. Sivaprakash and Ms. R Dhanya, SRM IST*

Course Code	18CEC303T	Course Name	HIGHWAY ENGINEERING AND DESIGN	Course Category	C	Professional Core Course	L	T	P	C
							2	1	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Understand the concepts in the geometric design of highway			
CLR-2 :	Learn the needs and concepts in horizontal and vertical alignment of highway			
CLR-3 :	Learn various traffic studies required for traffic management			
CLR-4 :	Learn the design of various infrastructure facilities required for the traffic			
CLR-5 :	Understand the material requirement of flexible pavement and design the pavement			
CLR-6:	Understand the components of rigid pavement and its design			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level o	Expected Prof	Expected Attain	Program Learning Outcomes (PLO)															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
					Engineering K	Problem Anal	Design & Dev	Analysi	Modern Tool	Society & Cu	Environment	Ethics	Indiv	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3	
CLO-1 :	Design the geometric cross-section of highway	2	85	80	H	H	M	H	-	-	M	-	-	-	-	-	M	-	-	
CLO-2 :	Design the horizontal and vertical alignment of highway	2	85	75	H	H	H	H	-	-	M	-	-	-	-	-	M	-	-	
CLO-3 :	Conduct various traffic studies and analysis the volume and speed data	2	80	75	M	H	L	L	-	-	M	-	-	-	-	-	M	-	-	
CLO-4 :	Plan and design the various infrastructure facilities required for the traffic	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-	
CLO-5 :	Execute the material and the structural design of flexible pavement	2	85	80	H	H	M	H	-	-	M	-	-	-	-	-	M	-	-	
CLO-6:	Execute the material and the structural design of flexible pavement	2	80	75	H	H	M	H	-	-	M	-	-	-	-	-	M	-	-	

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Highway Geometric Design*** *Elements of transportation Engineering*	*Extra widening and numerical examples*	***Traffic Facilities Design*** *Traffic signs and*	***Flexible Pavement*** *Component of Flexible pavement*	***Rigid Pavement*** *Components of Rigid pavement*
	SLO-2	*Overviewof the course*	*Method of attaining superelevation in curves*	*Road markings*	*Functions of each component*	*Components of Rigid pavement – Details of joints*
S-2	SLO-1	*Highway planning and Alignment*	*Set back distance and shift in curves with numerical examples*	*Channelization of traffic*	*Materials - Basic properties of bitumen*	*Stresses in Rigid pavement – Temperature stress*
	SLO-2	*Classification of rural and urban roads*	*Reverse curve and compound curve*	*Channelization layouts*	*Binder grade and classification*	*Stresses in Rigid pavement – Temperature stress – numerical examples*
S-3	SLO-1	*Cross sectional elements of roads*	*Design of vertical alignment – summit curve*	*Traffic rotary - design elements capacity of rotary*	*Materials – Soil and aggregate properties*	*Stresses in Rigid pavement – Wheel load stress*
	SLO-2	*Terrain classification and speed and geometric standards for different terrain*	*Design of vertical alignment – summit curve – numerical example*	*Capacity ofrotary*	*Resilient modulus of aggregate and soil*	*Stresses in Rigid pavement – Wheel load stress – Numerical examples*
S-4	SLO-1	*Sight Distance – Stopping sight distance – Concept and derivations*	*Design of vertical alignment – valley curve*	*Rotary design - Numerical Example*	*Materials – Bituminous concrete mix properties*	*Stress combinations and critical stress*
	SLO-2	*Stopping sight distance – Numerical examples*	*Design of vertical alignment – valley curve – Numerical example*	*Rotary design - Numerical Example*	*Materials – Types of bituminous concrete mix*	*Thickness of Rigid pavement*
S-5	SLO-1	*Overtaking sight distance – assumptions and derivations*	***Traffic studies*** *Fundamental traffic parameters - speed, density, volume, travel time*	*Grade separated intersection – Warrants and types*	*Bituminous concrete mix design*	*Design of Joint spacing*

	SLO-2	*Overtaking sight distance – Numerical examples*	*Headway, and spacing -time mean speed, space mean speed – spot speed*	*Layout of grade separated intersection*	*Bituminous concrete mix design*	*Design of Joint spacing – Numerical examples*
S-6	SLO-1	*Overtaking sight distance – Numerical examples*	*Traffic volume study – need and procedure*	*Elementsof traffic signal - headway, saturation flow*	*Flexible pavement design factor – Traffic factor*	*Dowel bar design*
	SLO-2	*Intersection sightdistance*	*Traffic volume calculation and analysis*	*Design principles of a traffic signal - Phase design, cycle time determination, green splitting*	*Traffic– equivalent single wheel load and standard axle load*	*Design of dowel bars – Numerical examples*
S-7	SLO-1	*Horizontal curve – circular curve radius*	*Spotspeed study – need and procedure*	*Two phase signal design – Numerical example*	*Traffic factor - truck factor, vehicle damage factor,number of repetition of standard axle load*	*Check for the adequacy of dowel bars – Numerical example*
	SLO-2	*Super elevation and minimum ruling radius*	*Traffic speed analysis*	*Two phase signal design – Numerical example*	*Number of repetition of standard axle load – Numerical examples*	*Check for the adequacy of dowel bars – Numerical example*
S-8	SLO-1	*Determination of radius and super elevation – numerical example*	*Speed study – Moving observer method*	*Three phase signal design- with exclusive pedestrian phase – Numerical example -*	*Design of flexible pavement – determination of pavement thickness (with unbounded layers)*	*Design of tie bars*
	SLO-2	*Determination of radius and super elevation – numerical example*	*Moving observer method – numerical calculation*	*Three phase signal design- with exclusive pedestrian phase – Numerical example -*	*Design of flexible pavement – determination of pavement thickness (with unbounded layers)*	*Design of tie bars – numericalexamples*
S-9	SLO-1	*Transition curve – length – assumptions and derivations*	*Parking study and demand analysis*	*Signal co-ordination*	*Design of flexible pavement – determination of pavement thickness (with bonded layers)*	*Codal provisions and issues in current design methods*
	SLO-2	*Transition curve – length – Numerical examples*	*Data to be studied in accident spots*	*Signal co-ordination – determination of bandwidth*	*Design of flexible pavement – determination of pavement thickness (with bonded layers)*	*Codal provisions and issues in current design methods*

Learning Resources	1. Chakroborthy and A. Das, "Principles of Transportation Engineering", Prentice-Hall of India, 2003 2. S. K. Khanna, C.E.G. Justo and A. Veeraragavan, "Highway Engineering", Revised 10th edition, Nem Chand &Bros., Roorkee, 2014. 3. Roess, R. P. McShane, W. R. & Prassas, E. S. (1998), Traffic Engineering, Prentice – Hall.	4. Papacostas, C. S. and Prevedouros, P.D. (2001) "Transportation Engineering and Planning", Prentice Hall of India Pvt. Ltd. 5. Kadiyali, L. R. (1987), "Traffic Engineering and Transportation Planning", Khanna Publishers, India. 6. Yang Huang, Pavement Analysis and Design, Pearson, 2004 7. NPTEL – Introduction to Transportation Engineering - https://nptel.ac.in/courses/105105107/ (as on 05.07.2019)

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of Assignments, Seminars, Tech Talks, Mini Projects, Case Studies, Self Study, MOOCs, Certifications, Conference Paper

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com	*Dr. Venkaiah Chowdary, Associate Professor, NITW, vc@nitw.ac.in*	*Dr.A.Padma Rekha, SRM IST*
Mr. Ankit Pachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org	*Dr. V Sunitha, Assistant Professor, NITT, sunitha@nitt.edu*	*Mr.G.Sivaprakash, SRM IST*

Course Code	18CEC304L	Course Name	CONSTRUCTION ENGINEERING & MANAGEMENT LABORATORY	Course Category	C	*Professional Core Course*	L	T	P	C
							0	0	2	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes/Standards**	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the basic skills in network framing*
CLR-2 :	*Identifying the Activity involved in construction projects*
CLR-3 :	*Understand the concept of Scheduling*
CLR-4 :	*Apply the concept of Planning and scheduling*
CLR-5 :	*Identify the resource requirement*
CLR-6 :	*Identify resource allocation*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	**Learning**			**Program Learning Outcomes (PLO)**														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level o	Expected Prof	Expected Attain	Engineering K	Problem Anal	Design & Dev	Analysi	Modern Tool	Society & Cul	Environment	Ethics	Indivi	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*Accrue the knowledge in Project network diagrams*	*3*	*85*	*75*	*H*	*H*	*-*	*-*	*-*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*H*	*-*	*-*
CLO-2 :	*Analyze the construction activities and activity sequence*	*2*	*85*	*75*	*H*	*H*	*-*	*-*	*-*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*H*	*-*	*-*
CLO-3 :	*Accrue the knowledge in different scheduling charts*	*2*	*85*	*75*	*H*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*H*	*-*	*H*	*-*	*-*
CLO-4 :	*Accrue the knowledge in planning of activities in order*	*2*	*85*	*75*	*H*	*H*	*-*	*M*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*H*	*-*	*-*
CLO-5 :	*Develop the schedule with resources*	*3*	*85*	*75*	*H*	*H*	*-*	*M*	*-*	*-*	*-*	*-*	*H*	*-*	*-*	*-*	*H*	*-*	*-*
CLO-6 :	*Analyze over allocation and under allocation of resources*	*3*	*85*	*75*	*H*	*H*	*-*	*M*	*-*	*-*	*-*	*-*	*H*	*-*	*-*	*-*	*H*	*-*	*-*

Duration (hour)		6	6	6	6	6
S-1	SLO-1	***MSP**- Basic Network diagrammes*	*Resource list*	*Complete schedule for Institutional projects*	*Activity Entry*	*Complete schedule for Residential projects*
	SLO-2	*Terms involved*	*Resource assigning*		*Activity Entry*	
S-2	SLO-1	*Activity in projects*	*Resource analysis*	*Complete schedule for Infra structure projects*	*Activity Entry*	*Complete schedule for Residential projects*
	SLO-2	*Activity sequence*	*Resource usage*		*Activity Entry*	
S-3	SLO-1	*Main activities and Sub activities*	*Cost analysis*	*Complete schedule for Infra structure projects*	*Resource list*	*Complete schedule for Institutional projects*
	SLO-2	*Relationship line and precedence relationship*	*Tracking*		*Resource assigning*	
S-4	SLO-1	*Calendar design and assign*	*Complete schedule for Residential projects*	***Primavera Basics***	*Resource analysis*	*Complete schedule for Institutional projects*
	SLO-2	*Gantt chart and PERT diagram*		*EPS*	*Resource usage*	
S-5	SLO-1	*Activity resource estimation*	*Complete schedule for Residential projects*	*OBS and WBS*	*Cost analysis*	*Complete schedule for Infra structure projects*
	SLO-2	*Activity duration estimation*		*Types of calendar*	*Tracking*	
S-6	SLO-1	*Activity entry*	*Complete schedule for Institutional projects*	*Relationship lines and Constraints*	*Linking WBS, OBS and EPS*	*Complete schedule for Infra structure projects*
	SLO-2	*Activity entry*		*New project Creation*	*Multiple project entry*	

Learning Resources	1. Laboratory Manual 2. Feigenbaum.L, "Construction Scheduling with Primavera Project Planner", Prentice Hall Inc., 1999. 3. "Project planning and management: Primavera Reference guide", CADD Centre training services 4. Paul F. Aubin, "Mastering Autodesk Revit Building", Cengage Learning, March 2006.	5. Robert M. Thomas, "Advanced AutoCAD Release" 12, ED 3, Wiley, John & Sons, Incorporated, 1993. 6. "Project planning and management: MS Project specially for Civil professional", CADD Centre training services 7. Geprge Omura," Introducing AutoCAD 2010 and AutoCAD LT 2010", Willey India Pvt. Ltd., 2010.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	-	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*
Level 2	Apply Analyze	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*
Level 3	Evaluate Create	-	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from Record and Model Examination.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Jayasankar K, Zonal Head (Technical Services) at ultraTech cement Limited, jayasankar2411@gmail.com	*Dr. Radhakrishna, R.V. College of Engineering (RVCE), radhakrishna@rvce.edu.in*	*Dr. L. Krishnaraj, SRMIST*
Mr. V. Krishnaraju,, Modec Offshore Production Systems, pvt,ltd, krishnaraju.vaithiyanathan@modec.com	*Dr. K.Yogeswari, B.S. Abdur Rahman Crescent Institute of Science and technology, yogeswari@crescent.education*	*Dr. M. Balasubramanian, SRMIST*

Course Code	18CEC304T	Course Name	CONSTRUCTION ENGINEERING AND MANAGEMENT	Course Category	C	*Professional Core Course*	L	T	P	C
							2	1	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes/Standards**	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**		
		1	2	3
CLR-1 :	*Identify the characteristics of project and planning aspects*			
CLR-2 :	*Solve the CPM and PERT problems and apply the concept of project planning*			
CLR-3 :	*Identify the techniques of project controlling and monitoring*			
CLR-4 :	*Analyse the project performance based on S-Curve and Earned Value*			
CLR-5 :	*Analyze the basic concepts of various resources and its importance*			
CLR-6 :	*Analyse the project performance based on Quality and Safety*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level o	Expected Prof	Expected Attain	**Program Learning Outcomes (PLO)**														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering K	Problem Anal	Design & Dev	Analysi	Modern Tool	Society & Cult	Environment	Ethics	Indivi	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*Accrue the knowledge the characteristics of project and planning aspects*	*2*	*85*	*75*	*H*	*L*	*M*	*-*	*L*	*-*	*-*	*-*	*H*	*H*	*H*	*M*	*H*	*-*	*-*
CLO-2 :	*Analyze the CPM and PERT problems and apply the concept of project planning*	*3*	*85*	*75*	*H*	*H*	*M*	*M*	*-*	*-*	*-*	*-*	*H*	*-*	*H*	*M*	*H*	*-*	*-*
CLO-3 :	*Accrue the knowledge project controlling and monitoring*	*2*	*85*	*75*	*L*	*H*	*M*	*H*	*M*	*-*	*-*	*-*	*M*	*-*	*H*	*M*	*H*	*-*	*-*
CLO-4 :	*Apply the mathematical techniques of S-Curve and Earned Value*	*3*	*85*	*75*	*H*	*H*	*M*	*H*	*-*	*-*	*-*	*-*	*L*	*M*	*H*	*M*	*H*	*-*	*-*
CLO-5 :	*Accrue the knowledge about Types of resourcesand its importance*	*2*	*85*	*75*	*H*	*L*	*L*	*L*	*-*	*M*	*H*	*L*	*-*	*-*	*H*	*M*	*H*	*-*	*-*
CLO-6 :	*Accrue comprehensive knowledge in Quality and safety*	*2*	*85*	*75*	*H*	*H*	*L*	*L*	*-*	*H*	*-*	*H*	*L*	*-*	*H*	*M*	*H*	*-*	*-*

Duration (hour)		**9**	**9**	**9**	**9**	**9**
S-1	*SLO-1*	*Basics of Construction- Unique features of construction*	*Work break-down structure*	*Planning and organizing construction site and resources*	*Resource Planning- Procurement, Identification*	*Quality control: concept of quality, quality assurance*
	SLO-2	*Construction projects types and features, Phases of a project*	*Activitylists*	*Site layout including enabling structures,*	*Types of resources, manpower, Equipment Material, Money, Time*	*Quality gurus*
S-2	*SLO-1*	*Project Life cycle*	*Estimating durations*	*developing site organization, Documentation at site*	*Systems approach In resource management, Characteristics of resources*	*TQM*
	SLO-2	*Construction project planning and competency skills*	*Sequence of activities, Activity utility data*	*Manpower:planning,*	*Resources Utilization, measurement of actual resources required-Tools for measurement of resources*	*use of manuals and checklists for quality control, role ofinspection*
S-3	*SLO-1*	*Stages of project planning: pre-tender planning*	*Techniques of planning- Bar charts, Gantt Charts.*	*organizing, staffing, motivation*	*Material: Functions of Material Management*	*Basics of statistical quality control*
	SLO-2	*Pre-construction planning,*	*Networks: Basic terminology,*	*Histograms and S-Curves*	*Inventory cost, ABC analysis*	*Cost Of Quality(COQ) y, Quality audits*
S 4-5	*SLO-1*	*Detailed construction planning*	*AOA, AON*	*Earned Value*	*EOQ Model*	*Failure Mode & Effects Analysis (FMEA)*
	SLO-2	*Agencies involved and their methods of execution*	*Types of precedence relationships, Preparation of CPM networks*	*Supervision, Record keeping,*	*Equipment: Classification of Construction Equipment*	*Risk, Risk Management process*
S-6	*SLO-1*	*Process of development of plans and schedules*	*Activityon link and activity on node representation,*	*Periodic progress reports, periodical progress meetings*	*Factors Behind the selection of Construction of equipment*	*Risk Identification Process*
	SLO-2	*Role of client and contractor*	*critical and semiCritical paths*	*Updating of plans: purpose*	*Depreciation, Methods of Calculating Depreciation*	*Safety, Health and Environment on project sites*
S-7	*SLO-1*	*Feasibility study - preliminary analysis - market, technical, financial,*	*Computation of float values*	*Frequency and methods of updating*	*Classes of Labour, Labour Productivity*	*accident Causation Theories*
	SLO-2	*economic and ecological - detailed market and demand analysis- detailed technical analysis*	*Crashing Technique*	*Classification of costs, timecost trade-off in construction projects*	*Cost of Labour, Labour schedule, optimum use Labour*	*accidents; their cause Effects and preventive measures*

S-8	SLO-1	*Time value of money, NPV*	*PERT- Assumptions underlying PERT analysis,*	*Common causes of time and cost overruns*	*Resource Scheduling- Bar chart, line of balance technique*	*Cost of Accidents*
	SLO-2	*Contracts and Types*	*determining three time estimates, analysis,*	*Corrective measures*	*Resource constraints and conflicts*	*Occupational health problems in construction*
S-9	SLO-1	*Important Terminologies: Delays, penalties and liquidated damages; Force Majeure, Suspension and Termination*	*Slack computations*	*Common Good Practices in Construction*	*Resource aggregation, allocation, smoothening and leveling*	*Organizing for safety and health.*
	SLO-2	*Bidding Process*	*Calculation of probability ofcompletion.*	*Basics of Modern Project management systems*	*Resource smoothening problems*	*Safety inspection, Safety Audit*

Learning Resources	1. *Kumar NeerajJha, "Construction project management", Dorling Kindersley,New Delhi.2013* 2. *Sengupta .B, Guha .H, "Construction management and planning", TataMcgrawHill,New Delhi,2001* 3. *Sharma .S.C, "Construction engineering and management",KhannaPublishers,Delhi,2008*	4. *Prasanna Chandra, "Planning, Analysis, Selection, Financing, Implementation, and Review", 7 thEdition,TataMcgrawHill,New Delhi,2001.* 5. *Principles of Construction Management https://nptel.ac.in/courses/105104161/* 6. *Project Planning & Control https://nptel.ac.in/courses/105106149/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*		*40%*		*40%*		*40%*		*40%*	
	Understand										
Level 2	Apply	*40%*		*40%*		*40%*		*40%*		*40%*	
	Analyze										
Level 3	Evaluate	*20%*		*20%*		*20%*		*20%*		*20%*	
	Create										
	Total	100 %		100 %		100 %		100 %		100 %-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Jayasankar k, Zonal Head (Technical Services) at UltraTech Cement Limited, jayasankar2411@gmail.com	*Dr. Radhakrishna, R.V. College of Engineering (RVCE), radhakrishna@rvce.edu.in*	*Dr. L. Krishnaraj, SRM IST*
Mr. V. Krishnaraju, Modec Offshore Production Systems Pvt. Ltd, krishnaraju.vaithiyanathan@modec.com	*Dr. K.Yogeswari,, B.S. Abdur Rahman Crescent Institute of Science and technology, yogeswari@crescent.education*	*Mr. N. Ganapathy Ramasamy, SRM IST*

Course Code	18CEE301T	Course Name	FOUNDATION ENGINEERING AND DESIGN	Course Category	E	*Professional Elective Courses*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CIVIL ENGINEERING*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understanding the essential steps involved in a Geotechnical Investigation*
CLR-2 :	*Analyze the principle types of foundation and the factors governing the choice of the most suitable type of foundation.*
CLR-3 :	*Get exposed to determination of bearing capacity of shallow foundation*
CLR-4 :	*Analyze the cause and remedial measures for settlement and slope failure*
CLR-5 :	*Get an insight into the load carrying capacity of pile foundation in the field condition*
CLR-6 :	*Understand and analyse the concept of earth pressure*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of	Expected Profi	Expected Attai	Engineering Kn	Problem Analys	Design & Develop	Investigations	Modern Tool Us	Society & Cultu	Environment a	Ethics	Individual & Tea	Communica	Project Mgt. & Fi	Life Long	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Identify the soil characteristics through geotechnical investigation*	*2*	*85*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-
CLO-2 :	*Proper type of foundation is chosen depending upon the soil condition*	*2*	*85*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-
CLO-3 :	*Compute g the bearing capacity of shallow foundation*	*2*	*80*	*75*	*H*	*H*	-	*H-*	-	-	-	-	-	-	-	-	*H*	-	-
CLO-4 :	*Utilize the proper measures for reducing the settlement and slope failure*	*2*	*85*	*80*	*H*	*H*	-		-	-	-	-	-	-	-	-	*H*	-	-
CLO-5 :	*Utilize the proper type of pile in the field*	*2*	*85*	*75*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	*H*	-	-
CLO-6 :	*Estimate of earth pressure for different soil condition*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Site investigation, soil Exploration*	*Definition: Foundation, purpose of foundation.*	*Combined footing - types*	*Deep foundation – Necessity. Pile Foundations classification*	*Lateral Earth Pressures Theories-Introduction:*
	SLO-2	*Planning and stages in site investigation*	*Definition: Shallow Foundation – classification. Ultimate, gross, net, safe bearing capacity. safe and allowable bearing pressure*	*Combined footing - types*	*Pile Foundations – classification*	*applications of earth pressure theories*
S-2	SLO-1	*Soil exploration – Methods – direct, semi-direct and indirect method*	*Bearing capacity failure - modes of shear failures – general, local and punching shear failure*	*Method of proportioning – Rectangular footing*	*Load carrying capacity of pile – Methods*	*Different types of earth pressure at rest, active and passive pressure*
	SLO-2	*Direct method – test pit, trenches*	*Factors affecting bearing capacity*	*Method of proportioning – Rectangular footing*	*Dynamic method – ENR, and Hiley's - Problems*	*Different types of earth pressure at rest, active and passive pressure*
S-3	SLO-1	*Indirect methods. Geophysical methods- Seismic Refraction Method*	*Bearing capacity determinations – Methods.*	*Method of proportioning – Trapezoidal footing*	*Static method – all type of soils - problems*	*Rankine's Earth Pressure Theory, active earth pressure and passive earth pressure for horizontal backfill for cohesion-less soil*
	SLO-2	*Geophysical methods- Electrical Resistivity Method*	*Terzaghi theory – Assumption.*	*Method of proportioning – Trapezoidal footing*	*Static method – all type of soils - problems*	*Rankine's Earth Pressure Theory, active earth pressure and passive earth pressure for horizontal backfill for cohesion-less soil*
S-4	SLO-1	*Indirect method – SPT*	*Bearing capacity – Strip and Square foundation*	*Combined footing - problems*	*Static method – all type of soils - problems*	*Rankine's Earth Pressure Theory, active earth pressure and passive earth pressure for horizontal backfill for cohesion-less soil-Problems*
	SLO-2	*Indirect method – SPT*	*Bearing capacity – Circular and Rectangular foundation*	*Combined footing - problems*	*Static method – all type of soils - problems*	*Rankine's Earth Pressure Theory, active earth pressure and passive earth pressure for horizontal backfill for cohesion-less soil-Problems*
S-5	SLO-1	*Indirect method – DCPT*	*Bearing capacity – effect of water table*	*Settlement – total and differential settlement.*	*Pile load capacity – penetration test results*	*Rankine's Earth Pressure Theory, active earth pressure and passive earth pressure for horizontal backfill for cohesive soils.*
	SLO-2	*Indirect method –SCPT*	*Bearing capacity – effect of water table*	*Settlement – total and differential settlement.*	*Pile load capacity – penetration test results*	*Rankine's Earth Pressure Theory, active earth pressure and passive earth pressure for horizontal backfill for cohesive soils*

S6	**SLO-1**	*Semi direct method Borings – auger*	*Bearing capacity - problems*	*Causes and methods to minimize the total settlement*	*Pile group – efficiency - problems*	*Rankine's Earth Pressure Theory, active earth pressure and passive earth pressure for horizontal backfill for cohesive soils-Problems*
	SLO-2	*Semi direct method Borings –shell and auger*	*Bearing capacity - problems*	*Causes and methods to minimize the total settlement*	*Pile group – efficiency - problems*	*Rankine's Earth Pressure Theory, active earth pressure and passive earth pressure for horizontal backfill for cohesive soils-Problems*
S-7	**SLO-1**	*Semi direct method Borings – wash boring and rotary drilling*	*Bearing capacity - problems*	*Causes and methods to minimize the differential settlement*	*Pile group – efficiency - problems*	*Earth pressure theories – Graphical method*
	SLO-2	*Semi direct method Borings – percussion method*	*Bearing capacity - problems*	*Causes and methods to minimize the differential settlement*	*Pile group – efficiency - problems*	*Earth pressure theories – Graphical method*
S-8	**SLO-1**	*Number and deposition of trail pits and borings*	*Hansen and IS code method*	*Slopes – types – Causes of slope failure*	*Pile load test : Types - Load carrying capacity of pile, under-reamed pile and pile group*	*Rebhann's Construction for Active Pressure*
	SLO-2	*Bore log details*	*Bearing capacity from Penetration test results*	*Methods to minimize the slope failure*	*load test as per BIS – estimation of load carrying capacity*	*Rebhann's Construction for Active Pressure*
S-9	**SLO-1**	*Soil Sample ; UDS*	*Bearing capacity : Plate load test as per BIS ,*	*Slope stability – methods - Swedish Method of Slice for a Cohesive-frictional Soil*	*Problems in pile load test.*	*Culmann'sgraphical solutions for active and passive case*
	SLO-2	*Soil Sample ; DS*	*limitations and estimation of settlements - Performance of foundation*	*Slope stability – methods - Swedish Method of Slice for a Cohesive-frictional Soil*	*Negative skin friction*	*Culmann'sgraphical solutions for active and passive case*

Learning Resources	*1. Joseph.E Bowles, "Foundation Analysis and Design", Mc Graw Hill Publishing co., 2001.* *2. Murthy .V.N.S, "Textbook of Soil Mechanics and Foundation Engineering", CBS Publishersand Distributors, New Delhi, 2009.* *3. Arora .K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2011.* *4. Varghese, P.C., "Foundation Engineering", PHI Learning New Delhi. 2011*	*5. Punmia.B.C., "Soil Mechanics and Foundations", Laxmi publications Pvt Ltd., 2000.* *6. Das .B.M, "Principles of Foundation Engineering", (Fifth Edition), Thomson Books, 2010.* *7. NPTEL Course – Advanced Foundation Engineering : https://nptel.ac.in/courses/105105039/* *8. NPTEL Course – Foundation Engineering : https://nptel.ac.in/courses/105101083/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*50%*	-	*40%*	-	*40%*	-	*45%*	-	*70%*	-
Level 2	Apply Analyze	*50%*	-	*60%*	-	*60%*	-	*55%*	-	*30%*	-
Level 3	Evaluate Create	-	-	-	-	-	-	-	-	-	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 : Assignments and / or Field visits

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. P.Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com	*Dr.M.Muttharam, Anna University, muttharam@annauniv.edu*	*Dr. P.T. Ravichandran, SRMIST*
Mr.Lenin K.R., Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in	*Dr.V.Murugaiyan, Pondichery Engineering College, vmurugaiyan@pec.edu*	*Ms. S. Mary Rebekah Sharmila, SRMIST.*

Course Code	18CEE302T	Course Name	GEOTECHNICAL DESIGN	Course Category	E	*Professional Elective Courses*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CIVIL ENGINEERING*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the essential steps involved in a Geotechnical Investigation*
CLR-2 :	*Understand the concept of consolidation and the estimation of preconsolidation pressure*
CLR-3 :	*Analyze the stress strain behavior of different types of soil*
CLR-4 :	*Compute of the ultimate load carrying capacity of shallow foundation under different field condition*
CLR-5 :	*Estimate of pile load capacity and settlement of single and group of piles*
CLR-6 :	*Utilize the ultimate loads of shallow and pile foundation in the civil engineering field*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	*2*	*3*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of	Expected Profi	Expected Attai	Engineering Kn	Problem Analys	Design & Deve	Investigations	Modern Tool Us	Society & Cultu	Environment &	Ethics	Individual & Tea	Communica	Project Mgt. & Fi	Life Long	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Analyze the soil properties based on geotechnical investigation*	*2*	*85*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-
CLO-2 :	*Utilize the preconsolidation pressure for determining the rate of consolidation*	*2*	*85*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-
CLO-3 :	*Utilize the stress strain behavior of soil in the field*	*2*	*80*	*75*	*H*	*H*	-	*M*	-	-	-	-	-	-	-	-	*H*	-	-
CLO-4 :	*Identify the application of ultimate loads of shallow foundation in the field*	*2*	*85*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-
CLO-5 :	*Identify the application of ultimate loads of pile foundation in the field*	*2*	*85*	*75*	*H*	*H*	-	*M*	-	-	-	-	-	-	-	-	*H*	-	-
CLO-6 :	*Apply of shallow and deep foundation in the field*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Planning of subsurface investigation*	*Terzaghi's theory of one dimensional consolidation*	*Stress and strain behavior of soil*	*Bearing capacity and settlement analysis of shallow foundations: Modes of failure*	*Pile foundation: Functions*
	SLO-2	*Purpose and scope*	*Terzaghi's theory of one dimensional consolidation*	*Stress and strain behavior of soil*	*Bearing capacity and settlement analysis of shallow foundations: Modes of failure*	*Pile foundation: Functions*
S-2	SLO-1	*Influence of soil conditions on exploratory program*	*Derivation of Terzaghi's equation (solution in detail need not be covered)*	*Triaxial test -drained and un-drained behavior of sand*	*Failure criteria, Prandtl Reissner Method, Assumptions - Estimation of ultimate loads,*	*Types of pile foundations*
	SLO-2	Type of foundation on exploratory program	*Derivation of Terzaghi's equation (solution in detail need not be covered)*	*Triaxial test -drained and un-drained behavior of sand*	*Failure criteria, Prandtl Reissner Method, Assumptions - Estimation of ultimate loads,*	*Types of pile foundations*
S-3	SLO-1	Subsurface soundings –Static methods	*Estimation of Cc and Cv from laboratory tests*	*Triaxial test -drained and un-drained behavior of clays*	*Terzaghi solution, Assumptions - Estimation of ultimate loads*	*Pile load tests, Use of load tests*
	SLO-2	Subsurface soundings –Static methods	*Estimation of Cc and Cv from laboratory tests*	*Triaxial test -drained and un-drained behavior of clays*	*Terzaghi solution, Assumptions - Estimation of ultimate loads*	*Pile load tests, Use of load tests*
S-4	SLO-1	Subsurface soundings – Dynamic methods	*Estimation of Cc and Cv from laboratory tests*	*Failure criteria in soils –only Mohr –Coulomb's criteria*	*Estimation of ultimate loads- Effect of shape,*	*Methods of estimation of pile load capacity- Static and dynamic*
	SLO-2	Subsurface soundings – Dynamic methods	*Estimation of Cc and Cv from laboratory tests*	*Failure criteria in soils –only Mohr –Coulomb's criteria*	*Estimation of ultimate loads- Effect of shape,*	*Methods of estimation of pile load capacity- Static and dynamic*
S-5	SLO-1	Planning of subsurface investigations	*Estimation of Pc by various methods*	*Ideal, plastic and real soil behavior*	*Estimation of ultimate loads- embedment of footing*	*Estimation of single pile capacity by static*
	SLO-2	Planning of subsurface investigations	*Estimation of Pc by various methods*	*Ideal, plastic and real soil behavior*	*Estimation of ultimate loads- embedment of footing*	*Estimation of single pile capacity by static*
S6	SLO-1	Planning of subsurface investigations	*Field consolidation curves*	*Shear strength of sand and clays*	*Estimation of ultimate loads- eccentricity in loading*	*Estimation of single pile by dynamic methods*

	SLO-2	Planning of subsurface investigations	*Field consolidation curves*	*Shear strength of sand and clays*	*Estimation of ultimate loads- eccentricity in loading*	*Estimation of single pile by dynamic methods*
S-7	**SLO-1**	Type and sequence of operations	*Quasi pre-consolidation*	*Estimation of stresses: Boussinesq's theory*	*Compressibility (including critical rigidity index), Choice of factor of safety, Settlement of foundations on sand –Schmertmann method*	*Group capacity of piles*
	SLO-2	Type and sequence of operations	*Quasi pre-consolidation*	*Estimation of stresses: Boussinesq's theory*	*Compressibility (including critical rigidity index), Choice of factor of safety, Settlement of foundations on sand –Schmertmann method*	*Group capacity of piles*
S-8	**SLO-1**	Lateral extent and depth of exploration	*Quasi Secondary consolidation*	*Estimation of stresses: Westergard's theory*	*Foundations on collapsing and swelling soils, non-uniform soils, compressible soils and on rock*	*Separation of skin friction and end bearing capacity*
	SLO-2	Lateral extent and depth of exploration	*Quasi Secondary consolidation*	*Estimation of stresses: Westergard's theory*	*Foundations on collapsing and swelling soils, non-uniform soils, compressible soils and on rock*	*Separation of skin friction and end bearing capacity*
S-9	**SLO-1**	Interpretation of field and laboratory data	*Practical applications*	*Estimation of stresses: Newmark's charts*	*Design of isolated and combined footings*	*Settlement of single and group of piles.*
	SLO-2	Interpretation of field and laboratory data	*Practical applications*	*Estimation of stresses: Newmark's charts*	*Design of isolated and combined footings*	*Settlement of single and group of piles.*

Learning Resources	*1. Joseph.E Bowles, "Foundation Analysis and Design", Mc Graw Hill Publishing co., 2001.* *2. Murthy .V.N.S, "Textbook of Soil Mechanics and Foundation Engineering", CBS Publishersand Distributors, New Delhi, 2009.* *3. Arora .K.R. "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 2011.* *4. Varghese, P.C., "Foundation Engineering", PHI Learning New Delhi. 2011*	*5. Punmia.B.C., "Soil Mechanics and Foundations", Laxmi publications Pvt Ltd., 2000.* *6. Das .B.M, "Principles of Foundation Engineering", (Fifth Edition), Thomson Books, 2010.* *7. NPTEL Course – Foundation Design : https://nptel.ac.in/courses/105104162/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*50%*	-	*40%*	-	*40%*	-	*45%*	-	*70%*	-
Level 2	Apply Analyze	*50%*	-	*60%*	-	*60%*	-	*55%*	-	*30%*	-
Level 3	Evaluate Create	-	-	-	-	-	-	-	-	-	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 : Assignments and / or Field visits

Course Designers		
Experts from Industry	*Experts from Higher Technical Institutions*	*Internal Experts*
Dr. P.Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com	*Dr.M.Muttharam, Anna University, muttharam@annauniv.edu*	*Dr. P.T. Ravichandran, SRMIST*
Mr.Lenin K.R., Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in	*Dr.V.Murugaiyan, Pondichery Engineering College, vmurugaiyan@pec.edu*	*Ms.S. Mary Rebekah Sharmila, SRMIST.*

Course Code	18CEE303T	Course Name	GROUND IMPROVEMENT TECHNIQUES	Course Category	E	Professional Elective Courses	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Understand the need for ground improvement			
CLR-2 :	Understand the techniques adopted for ground improvement with respect to hydraulic modification			
CLR-3 :	Identify conceptual and practical understanding of in-situ soil densification techniques			
CLR-4 :	Familiarize with soil chemical modification techniques and acquaintance with emerging technologies			
CLR-5 :	Understand the mechanism and concept related to soil modification by reinforcements			
CLR-6 :	Recommend and design cost effective ground improvement techniques for difficult practical soil conditions			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Learning			Program Learning Outcomes (PLO)														
		Level of	Expected Prof	Expected Attai	Engineering Kn	Problem Analys	Design & Develo	Analysis	Modern Tool Us	Society & Cultur	Environment & S	Ethics	Individual & Tea	Communica	Project Mgt. & Fi	Life Long	PSO - 1	PSO - 2	PSO - 3
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Gain a thorough knowledge on the role of ground improvement techniques in the infrastructure development	2	85	80	H	L	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Recommend hydraulic modification techniques for related problems	2	85	75	H	M	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-3 :	Apply densification techniques for loose sand deposits and alternative techniques for soft clay deposits	2	80	75	H	M	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-4 :	Recommend additives and frame soil chemical modification schemes for stabilizing problematic soil	2	85	80	H	M	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-5 :	Design geotechnical structures using reinforcements like reinforced earth retaining walls, slopes, foundations etc.,.	3	85	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-6 :	Recommend design efficient and economic alternatives using ground improvement techniques for problematic and difficult sites	3	80	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction-Ground improvement techniques	Hydraulic modification-concept and principle	In-situ densification of cohesionless soil	Grouting -introduction	Soil reinforcement concepts
	SLO-2	Role of ground improvement techniques in foundation engineering	Dewatering -objectives -types	Various Methods and mechanism involved	Necessity types of grout-suspension-solution grouts	Principle and mechanism
S-2	SLO-1	Objectives and scope of ground improvement techniques	Dewatering Techniques -well points system	Consolidation of cohesive soil-types	Functions of grouting-permeation	Reinforced earth retaining structures- various applicability in geotechnical engineering
	SLO-2	Classification of techniques adopted	Installation -mechanism and suitability of soil	Properties and behaviour	Functions-Compaction-hydro fracture	Embankments -slopes etc..
S-3	SLO-1	Hydraulic-Mechanical-Chemical-Reinforcement	Dewatering methods-Ditches	Vibrofloatation techniques	Grouting equipment and methods	Types of reinforcing materials
	SLO-2	Choice of method of ground improvement techniques	Dewatering methods-Sumps	Dry feed method-wet feed method	Grouting with soil, bentonite	Natural and manmade materials
S-4	SLO-1	Geotechnical problems in Lateritic soil	Dewatering methods -Vacuum method.	Sand compaction piles	Grouting with cement mixes	Geosynthetics-types
	SLO-2	Properties and behavior and techniques adopted	Dewatering methods-Electroosmotic method	Installation techniques	Mechanism and concept	Geotextile-geogrids-geonets
S-5	SLO-1	Geotechnical problems in Alluvial soil	Seepage analysis of 2-dimensional flow-concepts	Deep compaction -dynamic compaction -blasting technique	Grout injection methods	Functions of geosynthetics
	SLO-2	Properties and behavior and techniques adopted	Theory and problems	Concepts and factors influencing	grout monitoring schemes	Filtration, drainage
S6	SLO-1	Geotechnical problems in Black Cotton soil	Seepage analysis-fully penetrated slot	Stone columns -installation	Civil engineering application of grouting techniques	Geosynthetics-Reinforcement

	SLO-2	*Properties and behavior and techniques adopted*	*Theory and problems*	*Mechanism*	*Some of the field studies*	*Separation function -Geotechnical field application*
S-7	SLO-1	*Selection of suitable ground improvement techniques based on soil condition*	*Preloading-concept*	*Design criteria*	*Stabilization -concept*	*Geomembranes-containments*
	SLO-2	*Some field conditions for practical applicability*	*Field applicability*	*Stone column- soil criteria-field application*	*Stabilization of expansive soil*	*Barriers- field application*
S-8	SLO-1	*Use of Piezometers*	*Vertical drains-sand drains*	*Lime columns-applicability*	*Lime stabilization-concept-suitability criteria*	*Current practices-geosynthetics*
	SLO-2	*Field applications*	*Installation and mechanism*	*Soil criteria-mechanism involved*	*Mechanism involved*	*Field application reinforcement*
S-9	SLO-1	*Use of inclinometers*	*Prefabricated vertical drains*	*Field application*	*Cement stabilization -concept-suitability criteria*	*Geosynthetics in field applications*
	SLO-2	*Field applications*	*Installation and mechanism*	*Installation -mechanism*	*Mechanism involved*	*Introduction of ground anchors*

Learning Resources	*1. Purushothama Raj. P, "Ground Improvement Techniques", Lakshmi Publications, 2ndEdition, 2016.* *2. Manfired R. Hausmann, Engineering Principles of Ground Modification,McGraw-Hill Pub, Co., 1990.* *3. Koerner, R.M. "Construction and Geotechnical Methods in Foundation Engineering",McGraw Hill, 1994.* *4. Nihar Ranjan Patra, "Ground Improvement Techniques", Vikas Publishing House, FirstEdition, 2012.*	*5. Mittal.S, "An Introduction to Ground Improvement Engineering", Medtech Publisher, First Edition, 2013.* *6.NPTEL Course - Advanced Techniques in Geotechnical and Foundation Engineering : https://nptel.ac.in/courses/105106144/* *7. NPTEL Course - Ground Improvement Techniques : https://nptel.ac.in/courses/105108075/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*20%*	-	*30%*	-	30%	-	*30%*	-	30%	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. P.Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com	*Dr.M. Muttharam, Anna University, muttharam@annauniv.edu*	*Dr. P.T. Ravichandran, SRMIST*
Mr. K.R. Lenin Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in	*Dr.V. Murugaiyan, Pondichery Engineering College, vmurugaiyan@pec.edu*	*Dr. S. Bhuvaneshwari, SRMIST*

Course Code	18CEE304T	Course Name	FOUNDATION ON EXPANSIVE SOIL	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Understand the occurrence and distribution of expansive soils																		
CLR-2 :	Deals the properties of expansive soils																		
CLR-3 :	Identify the various methods of prediction of heave																		
CLR-4 :	Analyse the design procedure for foundation on expansive soils																		
CLR-5 :	Identify the various methods of stabilization used in expansive soils																		
CLR-6 :	Create overall knowledge on properties and performance of expansive soil and design of foundation on expansive soil																		

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of	Expected Prof.	Expected Attai	Engineering Kn	Problem	Analys	Design & Dev	Design	Modern Tool Us	Society & Cu	Environ & Sust	Ethics	Individual & Tea	Communica	Project Mgt. & Fi	Life Long	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Gaining the knowledge of the occurrence and distribution of expansive soils	2	85	80	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Identify the properties of expansive soils	2	85	75	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-3 :	Identify the knowledge on various methods of prediction of heave	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-4 :	Apply the design procedure for foundation on expansive soils	3	85	80	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-5 :	Analyse the various methods of stabilization used in expansive soils	2	85	80	H	H	-	M	-	-	-	-	-	-	-	-	H	-	-
CLO-6 :	Acquire knowledge on design of suitable foundations on expansive soil	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-

Duration (hour)		09	09	09	09	09
S-1	SLO-1	*Introduction- Expansive soils an overview*	*Soil structure – coarse grained soil*	*Clay mineralogy - Types of Clay minerals*	*Design alternatives*	*Methods Controlling Swelling characteristics of expansive soil – Prewetting*
	SLO-2	*Occurrence of expansive soil*	*Soil structure – Fine grained soil*	*Basic structural unit*	*Structural Alternatives – Soil Alternatives*	*Surface and subsurface drainage*
S-2	SLO-1	*Distribution of expansive soil*	*Composite structure*	*Synthesisation of clay mineral*	*Isolation of structre from soil*	*Treatment of expansive soils -Surcharge loading,*
	SLO-2	*Nature of expansive soil with moisture content*	*Specific surface - adsorbed and absorbed water*	*Properties and characterisation of clay minerals*	*Recommendations for type of foundation in expansive soils*	*Concept Moisture barriers - Horizontal moisture barriers*
S-3	SLO-1	*Environmental interaction*	*Field exploration methods soils - Sounding test*	*Minerological methods - X – Ray diffraction*	*Design consideration - Individual*	*Moisture barriers - Vertical moisture barriers*
	SLO-2	*Physical properties of expansive soils*	*Identification of expansive – laboratory methods*	*Differential Thermal Analysis*	*Design consideration - Continuous footings*	*Soil replacement with compaction control*
S-4	SLO-1	*Effect of expansive soils on structures*	*Atterberg limit*	*Electron microscopy*	*Stiffened mats - Codal provisions.*	*Soil Stabilization-concept*
	SLO-2	*Problems and Remedies of expansive soils*	*CEC*	*Potential Volume Change*	*Under reamed piles - Design*	*Mechanical stabilization – Types and concept*
S-5	SLO-1	*Identification of expansive soils*	*Swelling characteristics – Laboratory tests*	*Expansion Index Test*	*Under reamed piles construction*	*Chemical stabilisation*
	SLO-2	*Assessment of Expansion Potential*	*Swell potential identification from Atterberg limit*	*Coefficient Of Linear Extensibility (Cole)*	*Advantages and disadvantages of Under reamed piles*	*Cement stabilization- Advantages and disadvantages*
S6	SLO-1	*Moisture equilibrium – concept*	*Casagrande's PI-LL Chart*	*Methods of prediction of heave - Empirical methods*	*Double under reamed pile*	*Lime stabilization – mechanism involved and its limitations*
	SLO-2	*Stable and unstable zone*	*Swell potential identification from Activity index and particle size*	*Soil suction – Osmotic and matric*	*Load test on Under reamed pile*	*Bituminous stabilization*
S-7	SLO-1	*Shrink – swell potential of expansive soil*	*Diffferential free swell – classification using engineering properties*	*Measurement of soil suction - methods*	*Estimation of load carrying capacity from under reamed pile*	*Thermal stabilization- Thermal Technique-concept*
	SLO-2	*Field conditions that favour swelling*	*Swell Pressure mesaruement*	*Tensio meter*	*Belled piers – Bearing capacity and skin friction*	*Thermal stabilization – Freezing Technique-concept*

S-8	SLO-1	*Consequences of swelling*	*Analysis on swell pressure*	*Axis translation*	*Advantages and disadvantages of belled piers*	*Industrial waste in soil stabilisation*
	SLO-2	*Distress symptoms*	*Isomporphous substitution*	*Psychrometers*	*Stiffened slab on grade*	*Use of fly ash in soil stabilsation*
S-9	SLO-1	*Damage on Foundations from Expansive Soils*	*Diffused double layer of water*	*Filter paper method*	*Drilled pier and beam*	*Types of fly ash - characteristics*
	SLO-2	*Factors influencing swelling and shrinkage of soils*	*Specific surface area*	*Thermal Matric Potential Sensors*	*Underpinning method*	*Sustainable materials in stabilisation*

Learning Resources	1. *John .D.N & Debora .J.M, "Expansive Soils Problems and Practice In Foundation & Pavement Engineering", 1992.* 2. *Chenn.F.R, "Foundation on Expansive Soils"- Elsevier, 1973.*	3. *Parcher.J.V & Means .R.E, "Soil Mechanics and Foundations", Columbus, 1968.* 4. *Boominathan. S,"Lecture Notes on Structures on Expansive Soil", College of Engineering,Guindy, Anna University, Chennai. 1990.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*30%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	30%	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 : Assignments and / or Multiple choice Quizzes

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. P.Selvanambi, Divisional Engineer (Highways) , sundariselvam@yahoo.com	*Dr.M.Muttharam, Anna University, muttharam@annauniv.edu*	*Dr. P.T. Ravichandran, SRMIST*
Mr. K.R. Lenin., Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in	*Dr.V.Murugaiyan, Pondichery Engineering College, vmurugaiyan@pec.edu*	*Ms. Divya Krishnan K, SRMIST*

Course Code	18CEE406T	Course Name	REPAIR AND REHABILITATION OF STRUCTURES	Course Category	E	Professional Elective Courses	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	To assess the diagnosis of distress			
CLR-2 :	To provide an overview of performance of concrete structures			
CLR-3 :	To identify the sources of dampness and its prevention remedies			
CLR-4 :	To choose the appropriate material and its application			
CLR-5 :	To assess the extent of distress			
CLR-6 :	To study strengthening and demolition of structural component			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Prof	Expected Attain	Program Learning Outcomes (PLO)															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
					Engineering K	Problem Anal	Design & Deve	Investigati	Modern Tool	Society & Cul	Environment	Ethics	Indivi	Communica	Project Mgt.	Life Long L	PSO - 1	PSO - 2	PSO - 3	
CLO-1 :	Diagnosis the distresses	3	85	75	H	H	-	M	-	H	-	-	-	-	-	-	H	-	-	
CLO-2 :	Understand the performance of the concrete	3	85	75	H	H	-	M	-	H	-	-	-	-	-	-	H	-	-	
CLO-3 :	Sources of dampness and its remedies can be able to identify	3	85	75	H	H	-	M	-	H	-	-	-	-	-	-	H	-	-	
CLO-4 :	Know about types of materials and its selection	3	85	75	H	H	-	M	-	H	M	-	-	-	-	-	H	-	-	
CLO-5 :	Rectify the Distress in various structures	3	85	75	H	H	-	M	-	H	-	-	H	-	-	-	H	-	-	
CLO-6 :	Strengthen and demolish the structural components	3	85	75	H	H	-	M	-	H	M	M	H	-	-	-	H	-	-	

Duration (hour)		9	9	9	9	9
S-1	SLO-1	General Consideration – Distresses monitoring, Causes of distresses	Sources of dampness	Materials: Types	Distresses : Concrete Structures: Introduction, Causes of deterioration	General principle for Strengthening
	SLO-2	Defects due to climate, wear and erosion	Moisture movement from ground	Essential parameters for Materials	Diagnosis of causes, Flow charts for diagnosis	Relieving loads
S-2	SLO-1	Quality assurance & Inspection	DPC	Special Mortar And Concretes, Concrete Chemicals	Methods of repair – repairing, spalling and disintegration	Strengthening super structures
	SLO-2	Structural & Economic appraisal	Reasons for ineffective DPC	Special Cements	Repairing of concrete floors and pavements	Plating
S-3	SLO-1	Life Expectancy of Different Types of Buildings	Roof leakage - Pitched roofs	High Grade Concrete	Steel Structures : Types and causes for deterioration	Conversation to composite construction
	SLO-2	Influence of Environmental Elements on Buildings	Madras Terrace roofs	Expansive Cement	Types and causes for deterioration – preventive measures	Post stressing
S-4	SLO-1	Design and Construction Errors	Leakage of Concrete slabs	Polymer Concrete	Repair procedure - Brittle fracture	Jacketing
	SLO-2	Corrosion Mechanism	Protective Seal coatings	Epoxies, Resins	Lamellar tearing	Bonded overlays
S-5	SLO-1	Effect of Biological Agents	Ferro cement overlay	Surface Coatings	Defects in welded joints	Reinforcement addition
	SLO-2	Termite Control and Prevention	Resin or polymer slurry injection	Parameters & types of coatings	Mechanism of corrosion	Fiber wrap techniques
S-6	SLO-1	Chemical Attack on Building	Thin polymer overlay	Sulphur Infiltrated Concrete	Design of protect against corrosion	Pre placed aggregate concrete
	SLO-2	Aspects of Fire on Buildings	Thin epoxy overlay	Properties and application of SIFCON	Design and fabrication errors	Shortcrete

S-7	SLO-1	*Building Cracks Causes – diagnosis*	*Dampness in solid walls*	*Ferro cement*	*Distress during erection.*	*Strengthening concrete by surface impregnations*
	SLO-2	*Remedial measures*	*Condensation – hygroscopic salts*	*Application of Ferro cement*	*Masonry Structures: Discoloration and weakening of stones*	*Vacuum methods*
S-8	SLO-1	*Thermal cracks*	*Remedial treatments*	*Fiber Reinforced Concrete*	*Biotical treatments*	*Strengthening the substructures: Shoring*
	SLO-2	*Shrinkage cracks*	*Dry pack & epoxy bonded dry pack*	*Types and applications*	*Preservation – Chemical preservatives*	*Under pinning*
S-9	SLO-1	*Vegetation and trees*	*Chemical coating*	*Admixtures*	*Brick masonry structures*	*Increasing the load capacity of footing*
	SLO-2	*Foundation movements*	*Flexible and rigid coatings*	*Chemical and Mineral admixtures*	*Distresses and remedial measures.*	*Design for rehabilitation.*

Learning Resources	1. *"Handbook on repair and rehabilitation of RCC buildings", CPWD, Government of India, Government of India Press, India, 2011* 2. *Allen R.T and Edwards S.C, "Repair of Concrete Structures", Blakie and Sons, UK, 1987* 3. *Dayaratnam.P and Rao.R, "Maintenance and Durability of Concrete Structures", University Press, India, 1997.* 4. *Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical, UK, 1991.*	5. *Dodge Woodson.R,"Concrete Structures – protection, repair and rehabilitation", Elsevier Butterworth – Heinmann, UK, 2009.* 6. *Peter H.Emmons, "Concrete Repair and Maintenance Illustrated", Galgotia Publications Pvt. Ltd., 2001.* 7. *Raikar, R.N., "Learning from failures - Deficiencies in Design, Construction and Service" – Rand D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.* 8. *https://onlinecourses-archive.nptel.ac.in/noc19_mm06/preview*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Mr. Rajesh, Planning manager, Uthra Constructions, uthraconstructions@gmail.com	*Dr. E.B.Perumal Pillai, professor, Veltech University, ebppillai@yahoo.co.in*	*Mr.S.Manikandaprabhu, SRMIST*

Course Code	18CEE407T	Course Name	SUSTAINABLE CONSTRUCTION METHODS	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Identify the various formwork system for construction			
CLR-2 :	Analyze the basic concepts of functional requirement of building			
CLR-3 :	Explore the advanced concepts of green building construction			
CLR-4 :	Understand various concepts and applications of BIM			
CLR-5 :	Identify the various lean tools for sustainable construction			
CLR-6 :	Explore the knowledge in the field of energy efficiency of buildings			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Pro	Expected Attain	Program Learning Outcomes (PLO)														
					1 Engineering K	2 Problem A	3 Design & Dev	4 Analysi	5 Modern Tool	6 Society & Cul	7 Environment	8 Ethics	9 Indivi	10 Communica	11 Project Mgt.	12 Life Long L	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLO-1 :	Accrue the knowledge of various sustainable formwork system and formwork management	2	85	80	H	M	M	L	M	-	M	-	M	L	M	H	M	-	-
CLO-2 :	Apply the knowledge of planning, orientation, and selection of modern material for green building concepts	3	80	75	H	L	L	L	M	-	H	-	H	H	H	M	M	-	--
CLO-3 :	Accrue the knowledge of rating system for certification of green building	2	85	75	H	H	-	M	M	-	H	-	L	H	H	M	M	-	-
CLO-4 :	Utilize various concepts and applications of BIM	2	80	75	H	H	-	M	M	-	H	-	L	L	H	M	M	-	-
CLO-5 :	Apply the lean tools for sustainable construction	2	85	75	H	H	-	H	M	M	H	-	L	-	H	M	M	-	-
CLO-6 :	Accrue comprehensive knowledge in the field of energy efficiency of buildings	3	90	85	H	H	-	M	H	-	H	-	L	-	H	H	M	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Basics of Formwork and Staging	Principles of Planning	Green Building - Introduction	BIM –Introduction	Energy and Environment
	SLO-2	Form work materials	Planning Regulations and Byelaws	Benefits of Green Buildings,	Software's used for Building Information modeling	Energy efficiency and conservation
S-2	SLO-1	Types of form work	Orientation of Building	Green Building Materials and Equipment in India	Categories of BIM	Introduction to clean energy technologies
	SLO-2	Quantity calculation	Functional Requirements of a Building	Key Requisites for Constructing a Green Building	BIM in Project Development stage	Importance in sustainable development
S-3	SLO-1	Advancement of form work	Life-cycle assessment of construction building	Important Sustainable features for Green Building	BIM in Design stage	Energy consumption and sustainability
	SLO-2	System Formwork		Indian Green Building Council	BIM in Implementation stage	Future energy use - influenced by economic and environmental factors
S-4	SLO-1	Mivan form work system - basics	Traditional construction method	Green Building Moment in India	BIM in maintenance of buildings	Identification of energy related enterprises that represent the breath of the industry
	SLO-2					
S-5	SLO-1	Procedures of Mivan form work system	Advanced construction methods	Benefits Experienced in Green Buildings	Lean concepts	Energy Modeling
	SLO-2	Formwork for Structural system	Construction projects	Launch of Green Building Rating Systems	Application of lean tools in construction	Use as a tool for measuring sustainability
S-6	SLO-1	Foundation and wall formwork	Engineering Materials	Residential Sector	General Principles of passive Solar Heating	Energy Audit of Facilities
	SLO-2	Column, Beam, and slab formwork	Sustainable building materials	Opportunities of Green	General Principles of Passive Cooling	Optimization of energy consumption

				Building		
S-7	*SLO-1*	*Formwork for special structures*	*Environmental impact of materials*	*Green Building Features*	*Thermal Design of buildings Influence of Design Parameters – Mechanical controls*	*Energy efficiency ,an overview of design concepts, and architectural interventions*
	SLO-2	*Formwork for precast structures*	*Advantage and disadvantage*	*LEED India Rating System*	*Direct gain – Trombe Walls, Water Walls Radiant Barriers, Glazing material*	*Energy efficient buildings for various zones - cold, and cloudy*
S-8	*SLO-1*	*Formwork failure*	*Material selection to optimize performance Process for selection*	*Parameters for Rating system*	*Ventilation –Requirements – Minimum standards for ventilation*	*Cold and sunny; composite – hot and dry; moderate.*
	SLO-2	*Case studies*			*Ventilation Design ,Energy Conservation*	
S-9	*SLO-1*	*Pre award formwork management system*	*Green construction materials*	*HVAC System for Green Building*	*Ventilating systems – Design for Natural Ventilation*	*Warm and humidcase studies of residences*
	SLO-2	*Post award formwork management system*	*Production process*	*Design philosophy*	*Ventilation –Requirements – Minimum standards for ventilation*	*Applications of Operational Research in construction management*

Learning Resources	1. *Robert L. Peurifoy and Garold D. Oberlender, "Formwork for Concrete Structures", McGraw-Hill, 2006.* 2. *Hurd. M.K., "Formwork for Concrete", Special Publication No.4 Fifth Edition American Concrete Institute, Detroit, 2003.* 3. *A Text book of Building Construction, S.P. Arora and S.P. Bindra, DhanpatRai& Sons.* 4. *Handbook on Green Practices published by Indian Society of Heating Refrigerating and Air conditioning Engineers, 2009.*	5. *Green Building Hand Book by Tomwoolley and Samkimings, 2009.* 6. *Moore, F., "Environmental Control System", McGraw Hill Inc. 2002* 7. *Brown, G.Z. and DeKay, M., "Sun, Wind and Light – Architectural Design Strategies", John Wiley and Sons Inc, 2001* 8. *"Energy Conservation Building Code, Bureau of Energy Efficiency", New Delhi, 2007.* 9. *https://nptel.ac.in/courses/105102088/* *10.https://nptel.ac.in/noc/individual_course.php?id=noc19-ce40*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		-100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Mr. V. Krishnaraju, Modec Offshore Production Systems, krishnaraju.vaithiyanathan@modec.com	*Dr. S. Kamal, University College of Engineering, Ramnad, kamalselva21@gmail.com*	*Mr.N.Ganapathy Ramasamy, SRMIST*

Course Code	18CEE404T	Course Name	CONSTRUCTION EQUIPMENT AND AUTOMATION	Course Category	E	*Professional Elective course*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes/Standards**	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**		
		1	2	3
CLR-1 :	*Identify the management concepts of construction equipment*			
CLR-2 :	*Identify the various earthwork equipments and its applications in real projects*			
CLR-3 :	*Identify the various off shore equipments and techniques for dewatering*			
CLR-4 :	*Identify the various equipments used on aggregate and concrete production*			
CLR-5 :	*Analyze the basic concepts of methods and techniques on demolishing and dismantling structures*			
CLR-6 :	*Explore the advanced level of automated equipments for various construction activities*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level o	Expected Prof	Expected Attain	**Program Learning Outcomes (PLO)**														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysi	Modern Tool	Society & Culture	Environment Ethics	Indivi	Communica	Project Mgt.	Life Long L	PSO – 1	PSO – 2	PSO – 3	
CLO-1 :	*Accrue the knowledge of equipment management and cost controlling methods*	*2*	*85*	*75*	*H*	*M*	*-*	*L*	*-*	*-*	*-*	*H*	*M*	*M*	*H*	*H*	*M*	*-*	*H*
CLO-2 :	*Apply the knowledge of calculating productivity of earthwork equipments*	*3*	*85*	*75*	*H*	*H*	*-*	*L*	*L*	*-*	*-*	*-*	*H*	*H*	*H*	*M*	*M*	*-*	*H*
CLO-3 :	*Accrue the knowledge of equipments used in off shore construction practice*	*2*	*85*	*75*	*H*	*H*	*-*	*M*	*M*	*-*	*-*	*-*	*H*	*H*	*H*	*M*	*M*	*-*	*H*
CLO-4 :	*Accrue the knowledge of equipments used for aggregate and concrete production, techniques for demolition*	*3*	*85*	*75*	*H*	*H*	*-*	*M*	*M*	*-*	*-*	*-*	*H*	*H*	*H*	*M*	*M*	*-*	*H*
CLO-5 :	*Apply the knowledge in demolition and dismantling the distressed structures*	*2*	*85*	*75*	*H*	*H*	*-*	*H*	*M*	*-*	*-*	*-*	*H*	*H*	*H*	*M*	*M*	*-*	*H*
CLO-6 :	*Accrue comprehensive knowledge of automation in construction practices*	*2*	*85*	*75*	*H*	*H*	*-*	*M*	*H*	*-*	*-*	*-*	*H*	*H*	*H*	*H*	*M*	*-*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction on Construction Equipment*	*Earth Moving operations*	*Dredging equipment*	*Drilling equipments*	*Lifting equipments*
	SLO-2		*Types of Earthwork Equipment*	*Types of Dredging equipment*	*Types of Drilling equipments*	*Material handling equipments*
S-2	SLO-1	*Equipment Management in Construction Projects*	*Earthwork Equipment - Tractors*	*Types of trenching equipment*	*Principles of Blasting*	*Hoisting Equipments*
	SLO-2	*Management Programme*	*capacity calculations*		*Types of Blasting equipment*	*Types and safety precautions*
S-3	SLO-1	*Maintenance and Safety management*	*Earthwork Equipment - Motor Graders*	*Concept of Pipe jacking techniques*	*Aggregate production equipment*	*Slip form techniques*
	SLO-2	*Equipment requirement for construction project*	*Capacity calculations*	*Equipment used for Pipe jacking*	*Crushers*	
S-4	SLO-1	*Planning of Equipment*	*Earthwork Equipment - Scrapers,*	*Compaction equipments*	*Various types of crushers, feeders and screening equipments*	*Equipments for Conveyors*
	SLO-2	*Selection of Equipment*	*capacity calculations*	*Types of Compaction equipments*		*Types of Conveyors*
S-5	SLO-1	*Cost Control of Equipment*	*Earthwork Equipment - Front end Loaders*	*Pumping and Dewatering equipments*	*Concrete mixers*	*Prestressing techniques*
	SLO-2	*Depreciation on Equipment*	*capacity calculations*	*Types of pumps*	*Types of concrete mixers*	*Insitu prestressing in high rise structures*
S-6	SLO-1	*Conventional construction methods*	*Earthwork Equipment – Bull dozer*	*Well point Dewatering system*	*Pouring and pumping of concrete*	*Aerial transportations*
	SLO-2		*Capacity calculations*	*Vacuum dewatering of concrete flooring*	*Precautions*	*Applications and applications*

S-7	SLO-1	*Mechanized methods*	*Earthwork Equipment – Excavators*	*Pile Driving Equipments*	*Ready mix concrete - concept and procedure*	*Robots in construction*
	SLO-2	*Advanced Mechanized methods*	*Capacity calculations*	*Types and methods*		*Different automated equipments*
S-8	SLO-1	*Types of construction project*	*Equipments Used for Box Jacking Techniques*	*Concept of Coffer dam*	*Demolition equipment*	*Conventional plastering machines*
	SLO-2	*Types of construction equipment*		*Sheet piling*	*Controlled demolition techniques*	*Use of robots for repetitive activities*
S-9	SLO-1	*Safety Management*	*General safety in excavations*	*Tunneling equipments*	*Sequence of demolition*	*Drones in construction*
	SLO-2	*Safety measures*		*Methods of tunneling*	*Procedure for Dismantling*	*Advantages of drones*

Learning Resources	1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder.C, "*Construction Planning Equipment and Methods*", McGraw Hill. Singapore 2005. 2. Sharma S.C. "*Construction Equipment and Management*", Khanna Publishers, Delhi, 2008. 3. Deodhar, S.V. "*Construction Equipment and Job Planning*", Khanna Publishers Delhi, 2008.	4. Mahesh Varma .Dr., "*Construction Equipment and its planning and application*", Metropolitan Book Company, New Delhi,2003. 5. *https://nptel.ac.in/courses/105104161/12* 6. *https://nptel.ac.in/courses/105103023/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100%	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Mr. K. M. Nanthan, , L&T, RKMNNN@Intecc.com	Dr. J. Saravanan, Annamalai University, ausjs5070@gmail.com	*Mr. S. Prakashchander, SRMIST*

Course Code	18CEE405T	Course Name	CONTRACTS MANAGEMENT	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	To understand Indian Contract Act and to know the various types of construction contracts and their legal aspects			
CLR-2 :	Learn about contracts and agreements			
CLR-3 :	Acquire the knowledge of FIDIC concepts			
CLR-4 :	Apply the concept of various types of taxes			
CLR-5 :	Learn about the different types of labour laws			
CLR-6 :	Utilize the knowledge of labour laws and legal requirements in broader perspective			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level	Expected Prof.	Expected Attain	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Understanding the method of quoting the rates for bidding and tender process	3	85	75	H	M	-	-	-	M	-	H	H	M	L	M	H	-	L
CLO-2 :	Knowing the types of contracts	2	85	75	H	H	-	-	-	M	-	H	H	M	L	M	H	-	L
CLO-3 :	Steps involved in making contracts and records to be maintained in execution of contract	2	85	75	H	H	-	-	-	M	-	H	M	M	L	M	H	-	L
CLO-4 :	Knowledge in legal requirements in construction	2	85	75	H	M	-	-	-	L	-	H	M	M	L	M	H	-	L
CLO-5 :	Awareness of labour laws and Indian Contract Act	2	85	75	H	L	-	-	-	L	-	H	M	M	L	M	H	-	L
CLO-6 :	Acquiring knowledge to execute a contract	2	85	75	H	H	-	-	-	M	-	H	H	M	L	M	H	-	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Indian contract act	Tender- Definitions and Methods	Construction claims: Extra items and causes of claims	Legal Requirements- Insurance and Bonding	Labour Regulations-social security
	SLO-2	Definitions and important terms. Clause 1-75	Need for tendering, agreements and bonds in tendering process	Types of construction claims, documentation	Types of insurance	Welfare legislation
S-2	SLO-1	Elements of contract	Notice inviting tender	Settlement of claims	Laws governing sale	Laws relating to wages, Bonus and industrial disputes
	SLO-2	Types of contract – Legal parlance, Engineering contracts	Tender- Prequalification process	Arbitration- comparison and action of laws	Purchase and sale of urban and rural land	Labour administration
S-3	SLO-1	Features and suitability	Bidding, Accepting	Agreements, subject matter	Land revenue codes	Insurance and safety regulations
	SLO-2	Design of contract documents	Evaluation of technical, contractual and commercial point of view	Causes of disputes and importance of role of various stakeholders in prevention of disputes	Tax laws- income tax, sales tax ,VAT	Workmen compensation act
S4	SLO-1	International contract document	One cover and two cover system	Alternate dispute resolution methods	Excise on custom duties and their influence on construction cost	Indian factory act
	SLO-2	Standard contract document	Contract formation and interpretation	Violations, Appointment of arbitrator	Legal requirements for planning	Child labour act
S-5	SLO-1	Importance of breach of contract	Potential contractual problems	Conditions of arbitrator Powers and duties of arbitrator	Property law, Agency law	Maternity act
	SLO-2	Law of torts	World bank procedures and guidelines	Rules of evidences	Local government laws for approval	Minimum wages act
S-6	SLO-1	Special and general conditions of contract	Tamilnadu transparency in tenders Act.	Dispute review boards	Statutory regulations	Payment of wages act,1936

	SLO-2	Introduction to FIDIC contracts and types	EMD, SD	Indian arbitration and conciliation act1996	The companies act 1956: nature and definition of a company	Industrial dispute act
S-7	SLO-1	ICE conditions- introduction	Environmental provisions for construction contracts	Difference between 1940 act and 1996 act	Registration and incorporation	Domestic engaging of misconduct
	SLO-2	Evaluation of FIDIC document, types	Duties and responsibilities- engineers and contractors, Project manager, owner	Extent application of 1996 act. objectives and general provisions	Memorandum of association	The Tamilnadu and country planning act
S-8	SLO-1	Design and build contract, EPC contract	Important site documents	Conciliation and its provisions in the act	Articles of association,, prospectus, kinds of company	Building and other construction works act,1996
	SLO-2	Short forms contract-colour code	Process of building permissions	Conduct of conciliation and arbitral proceedings, ground for challenge	Directors: powers, duties, meetings and winding up	Employees state insurance act,1948
S-9	SLO-1	Various conditions of red book	Provisions for scheduling delays and accelerations	Procedure of appeal against the awards.	Managing performance- introduction, monitoring and performance	Contract labour act,1970
	SLO-2	Case study	Case study	Case study	Case study	Case study

Learning Resources	1. John G. Betty., "Engineering Contracts", McGraw Hill,2003 2. Gajaria G.T., "Laws Relating to Building and Engineering Contracts in India", M. M. Tripathi Private Ltd., Bombay, 1982 Tamilnadu PWD Code, 2006. 3. Jimmie Hinze, "Construction Contracts", McGraw Hill, 2001	4. Joseph T. Bockrath, "Contracts, the Legal Environment for Engineers and Architects", McGraw Hill, 2000. 5. Lecture Notes, "Legal Aspects for Civil Engineers, Short Term Course organized by SRMEC", 29th May to 4th June, 2002. 6. https://nptel.ac.in/courses/105103093/11 7. https://nptel.ac.in/syllabus/105102013/

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40	-	30	-	40	-	30	-	40	-
	Understand										
Level 2	Apply	40	-	40	-	40	-	30	-	40	-
	Analyze										
Level 3	Evaluate	20	-	30	-	20	-	40	-	20	-
	Create										
	Total	100 %		100 %		100 %		100 %		100%	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers

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Course Code	18CEE401T	Course Name	PAVEMENT ANALYSIS AND DESIGN	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Learn layered structure stress-strain analysis			
CLR-2 :	Understand the viscoelastic characterization of the material			
CLR-3 :	To impart basic knowledge on various bituminous technology and its characterization			
CLR-4 :	Familiarize with the design of flexible pavement			
CLR-5 :	Study about the distress of pavements			
CLR-6 :	Knowabout the pavement condition survey			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level	Expected Pro	Expected Attain	Program Learning Outcomes (PLO)														
					1 Engineering K	2 Problem Anal	3 Design & Dev	4 Analysis	5 Modern Tool	6 Society & Cul	7 Environment	8 Ethics	9 Indiv	10 Communica	11 Project Mgt.	12 Life Long L	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLO-1 :	analyze the critical conditions of the layered structure	2	85	80	H	H	M	L	H	-	H	-	-	-	-	-	M	-	-
CLO-2 :	Predict the real time behavior of the material	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-3 :	Select appropriate material for the bituminous pavement construction	2	80	75	H	H	M	M	-	-	H	-	-	-	-	-	M	-	-
CLO-4 :	Design the flexible pavement for different conditions of traffic and with different material combination	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-5 :	Evaluate the existing condition of the pavement	2	85	80	H	H	M	M	L	-	M	-	-	-	-	-	M	-	-
CLO-6 :	Suggest the suitable measures to improve the condition of the pavement	2	80	75	H	H	M	-	-	-	M	-	-	-	-	-	M	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Stress Analysis of Layered Structure***: *Importance of pavement design*	***Viscoelasticity:*** *Introduction to viscoelasticity*	***Pavement Materials:*** *Bitumen.*	***Design of Flexible pavement:*** *Different layers of flexible pavement*	***Evaluation of pavement:*** *Distress in flexible pavement*
	SLO-2	*Overview of layered system*	*Creep and recovery*	*Modified bitumen*	*Design factors*	*Distress in flexible pavement*
S-2	SLO-1	*Single layer system- stress analysis*	*Stress relaxation*	*Bitumen emulsion-Types*	*Traffic factors*	*Distress of rigid pavement*
	SLO-2	*Single layer system- stress analysis*	*Viscoelastic models*	*Grading of bitumen*	*Traffic factors*	*Distress of rigid pavement*
S-3	SLO-1	*Solving problems*	*Viscoelastic solid model*	*Performance grading*	*Material characteristics*	*Evaluation of distress*
	SLO-2	*Solving problems*	*Derivation of Voigt-Kelvin model*	*Aging of binder*	*Temperature*	*Distress measurement-Surface roughness*
S-4	SLO-1	*Two-layer pavement- stress analysis*	*Creep and recovery response of Voigt-Kelvin model*	*Bituminous mixture*	*Critical locations in pavement*	*Skid resistance*
	SLO-2	*Two-layer pavement- stress analysis*	*Stress relaxation response of Voigt-Kelvin model*	*Hot mix asphalt mixture*	*Pavement design as per IRC*	*Deflection measurements*
S-5	SLO-1	*Solving problems*	*Viscoelastic fluid model*	*Warm mix asphalt mixture*	*Solving problems-VDF*	*Benkelman beam test - concept*
	SLO-2	*Solving problems*	*Derivation of Maxwell model*	*Half warm mix asphalt mixture*	*Solving problems-VDF*	*Benkelman beam test – Method of measuring deflection*
S-6	SLO-1	*Multilayered stress analysis*	*Creep and recovery response of Maxwell model*	*Cold mix asphalt mixture*	*Solving problems-Pavement Design*	*Falling weight deflectometer-Working principle*
	SLO-2	*Multilayered stress analysis*	*Stress relaxation response of Maxwell model*	*Cold mix asphalt mixture*	*Solving problems-Pavement Design*	*Fallingweightdeflectometer-Calculation of moduli*
S-7	SLO-1	*Multilayered stress analysis*	*Burger's model*	*Mixture characterization - Resilient modulus*	*Solving problems-Pavement Design*	*Design of overlay by Benkelman beam method*
	SLO-2	*Multilayered stress analysis*	*Derivation of Burger's model*	*Mixture characterization - Determination of resilient modulus*	*Solving problems-Pavement Design*	*Design procedure*

S-8	**SLO-1**	*Software demo for multilayered structure*	*Oscillatory shearing*	*Mixture characterization - Dynamic modulus*	*Airfield pavement*	*Design procedure*
	SLO-2	*Software demo for multilayered structure*	*Response of elastic material to Oscillatory shearing*	*Mixture characterization - Determination of dynamic modulus*	*Specifications of airfield pavement*	*Solving problems*
S-9	**SLO-1**	*Software demo for multilayered structure*	*Response of viscous material to Oscillatory shearing*	*Mixture characterization - Time-temperature superposition*	*Design procedure of airfield pavement*	*Solving problems*
	SLO-2	*Software demo for multilayered structure*	*Response of viscoelastic material to Oscillatory shearing*	*Mixture characterization – Rutting and fatigue characterization*	*Design procedure of airfield pavement*	*Solving problems*

Learning Resources	*1. Yang Huang, Pavement Analysis and Design, Pearson, 2004* *2. Chakroborthy and A. Das, Priciples of Transportation Engineering, Prentice-Hall of India,2003* *3. S. K. Khanna, C.E.G. Justo and A. Veeraragavan, Highway Engineering, Revised 10th edition, Nem Chand &Bros., Roorkee, 2014.* *4. Yoder,E.J., and Witczak, Principles of Pavement Design, 2nd ed.John Wiley and Sons, 1975.*	*5. Wineman, A.S. and Rajagopal, K. R, Mechanical Response Of Polymers: An Introduction, Cambridge University Press, 2000.* *6.Guidelines for the Design of Flexible Pavements, IRC :37, The Indian Road Congress, New Delhi* *7. Subash C, Saxena, Textbook of Highway and Traffic Engineering, CBS Publishers, 1st Edition,2014* *8.NEPTEL link - https://nptel.ac.in/courses/105105107/1 and https://nptel.ac.in/courses/112104040/12 (as on 05.07.2019)*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conference Paper

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com	*Dr. VenkaiahChowdary, Associate Professor, NITW, vc@nitw.ac.in*	*Dr. A. Padma Rekha, SRM IST*
Mr.AnkitPachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org	*Dr. V Sunitha, Assistant Professor, NITT, sunitha@nitt.edu*	*Ms R Dhanya, SRM IST*

Course Code	18CEE402T	Course Name	RAILWAY, AIRPORT AND HARBOUR ENGINEERING	Course Category	E	Professional Elective Courses	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Get exposed to Railway track planning and design			
CLR-2 :	Understand the process of operation and maintenance of Railway track			
CLR-3 :	Attain knowledge on the concepts of planning and design of airport components			
CLR-4 :	Learn the structural design of the airfield pavement			
CLR-5 :	Understand the process in the Evaluation of the airfield pavement			
CLR-6 :	Acquire knowledge on the site characteristics and component planning for harbour			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level of	Expected Pro	Expected Attai	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering K	Problem A	Design & D	Analysis	Modern Tool	Society & C	Environment &	Ethics	Individ	Communica	Project Mgt. & Fi	Life Long	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Apply the planning and design concepts of railway alignment and geometric design of railway track	2	85	80	H	H	M	L	-	L	H	-	-	-	-	L	M	-	-
CLO-2 :	Plan and design the operational facilities for effective rail transportation	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-3 :	Apply the planning and design concepts of airport components	2	80	75	H	H	M	M	-	L	H	-	-	-	-	L	M	-	-
CLO-4 :	Design the airfield pavement	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-5 :	Evaluate the airfield pavement	2	85	80	H	H	M	M	L	L	M	-	-	-	-	L	M	-	-
CLO-6 :	Understand the basic need for handling the cargos in the harbour	2	80	75	H	H	M	-	-	L	M	-	-	-	-	-	M	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***RAILWAY PLANNING AND DESIGN*** *Introduction to railway engineering*	*Numericals in length of transition curve*	**AIRPORT PLANNING AND GEOMETRIC DESIGN** Importance and limitations	**PAVEMENT DESIGN AND EVALUATION** *Importance of pavement design and evaluation*	**HARBOUR ENGINEERING** *Importance of Harbour Engineering*
	SLO-2	*Role of Indian Railways in National Development*	*Numericals in length of transition curve*	*Characteristics of Air travel.*	*Components of airfield pavement*	*History and modern trends of waterway transportation,*
S-2	SLO-1	*Track Alignment -Importance*	*Widening of Gauges in Curves , Gradients Grade Compensation*	*Airport Master Plan, Evaluation and Institutional arrangements*	*Wheel and Axle Configurations*	*Definition of Terms - Harbours, Ports, Docks, ,*
	SLO-2	*Obligatory points in railway track alignment*	*Vertical Curves*	*Site Selection and survey,*	*Traffic considerations*	*Tides and Waves, Sounding, Littoral Drift*
S-3	SLO-1	*Engineering Surveys for Track Alignment*	**RAILWAY TRACK OPERATION AND MAINTENANCE**	*Components of airport- Runway Orientation,*	*Stress and strain analysis in airfield pavement*	*Classification of Harbours*
	SLO-2	*Remote Sensing, GIS &GPS, EDM and other equipment*	*Turnouts – Types - Working Principle*	*Cross wind Component, Wind rose Diagram*	*Stress and strain analysis in airfield pavement*	*Site Selection and harbour planning*
S-4	SLO-1	*Permanent Way and its components*	*Signaling*	*Numericals in Type I and II Wind Rose Diagram*	*Numericals in stress and strain*	*Types of Layouts of ports and components*
	SLO-2	*Functions of each component -Concept of Gauges*	*Interlocking*	*Basic Runway length and Corrections*	*Numericals in stress and strain*	*Approach facilities- With head gates, Without head gates*
S-5	SLO-1	*Gauges and the type of gauges*	*Track Circuiting*	*Numericals in Corrections of BRL*	*Cummulative Damage Factor*	*Protection facilities*
	SLO-2	*Coning of Wheels, Creeps and kinks*	*Construction & Maintenance Materials,*	*Numericals in Corrections of BRL*	*Environmental factors*	*Breakwater and its types*
S-6	SLO-1	*Geometric Design of Railway Tracks - basic terms and representations*	*Track Drainage*	*Airport classification, Geometric design and specifications of runway*	*FAARFIELD input*	*Docking facilities*
	SLO-2	*Super-Elevation, Negative superelevation*	*Track Modernization*	*Geometric Design elements and specifications of taxiway*	*Design of airfield pavement using FAARFIELD*	*Wet docks and Dry docks*
S-7	SLO-1	*Numericals in design of superelevation*	*Automated maintenance and upgrading, Technologies,*	*Runway patterns - Minimum Separation Distances*	*Pavement Evaluation - importance*	*Navigational Aids - Buoys and Beacons*

	SLO-2	*Numericals in design of superelevation*	*Re-laying of Track*	*Clearance over Highways and Railways*	*Method of evaluation and overview*	*Light ships, Light house*
S-8	**SLO-1**	*Numericals in design of superelevation*	*Lay outs of Railway Stations and Yards,*	*Drainage - Airport Zoning*	*Structural Evaluation - test procedure*	*Storage Facilities*
	SLO-2	*Numericals in design of superelevation*	*Rolling Stock*	*Aircraft parking systems*	*Structural Evaluation - evaluation techniques*	*Dolphins*
S-9	**SLO-1**	*Horizontal Curves, Transition Curves,*	*Tractive Power, Track Resistance*	*Visual Aids , Wind Direction Indicators*	*Functional Evaluation - test procedure*	*Mooring Accessories*
	SLO-2	*Numericals in length of transition curve*	*Numericals in Tractive resistance*	*Runway and Taxiway Markings and Lightings*	*Functional Evaluation - evaluation techniques*	*Dredging facilities*

Learning Resources	1. SaxenaSubhash C and Satyapal Arora, "*A Course in Railway Engineering*", DhanpatRai and Sons, Delhi, 1998. 2. Khanna S K, Arora M G and Jain S S, "*Airport Planning and Design*", Nemchand and Brothers, Roorkee, 1994. 3. R Horonjeff and F X Mckelvy, Planning and design of Airport, Mc-Graw Hill International Editions, 1993	4. R. Srinivasan, "*Harbour, Docks and Tunnel Engineering*", Charotar Publishing home, 27th Edition, 2015 5. S P Bindra, "*A Course in Docks and Harbour Engineering*", DhanpatRai and Sons, NewDelhi, 1993. 6. NPTEL link - https://nptel.ac.in/courses/105107123/ (as on 05.07.2019)

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of Assignments, Seminars, Tech Talks, Mini Projects, Case Studies, Self Study, MOOCs, Certifications, Conference Paper

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com	*Dr. VenkaiahChowdary, Associate Professor, NITW, vc@nitw.ac.in*	*Dr. A. Padma Rekha, SRM IST*
Mr.AnkitPachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org	*Dr. V Sunitha, Assistant Professor, NITT, sunitha@nitt.edu*	*MsArunimaJayakumar, SRM IST*

Course Code	18CEE403T	Course Name	TRAFFIC ENGINEERING AND MANAGEMENT	Course Category	E	Professional Elective Courses	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Understand the basics of traffic flow modelling.			
CLR-2 :	Familiarize the microscopic modelling			
CLR-3 :	Learn and understand the level of service of traffic flow			
CLR-4 :	Address the issues related to flow interruptions			
CLR-5 :	Learn and design the facilities required for the traffic control measures			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level o	Expected Pro	Expected Attain	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering K	Problem	Analysis	Design & Dev	Analysis	Modern Tool	Society & Cul	Environment	Ethics	Indivi	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Develop model for the traffic stream parameters	2	85	80	H	H	M	L	-	L	H	-	-	-	-	L	M	-	-
CLO-2 :	Create the microscopic models of the traffic flow	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-3 :	Apply the qualitative rankings on uninterrupted flow	2	80	75	H	H	M	M	-	L	H	-	-	-	-	L	M	-	-
CLO-4 :	Provide the facilities for interrupted flow	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-5 :	Apply the concept of traffic control measures	2	85	80	H	H	M	M	L	L	M	-	-	-	-	L	M	-	-
		2	80	75	H	H	M	-	-	L	M	-	-	-	-	-	M	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***TRAFFIC STREAM MODELLING*** *Importance of traffic Engineering and need for flow modelling*	***MICROSCOPIC TRAFFIC FLOW MODELLING*** *Concepts of microscopic modeling*	***UNINTERRUPTED FLOW*** *Concept of uninterrupted flow*	***INTERRUPTED FLOW*** *Concept of interrupted flow - intersections*	***TRAFFIC CONTROL*** *Various traffic control measures*
	SLO-2	*Importance of traffic Engineering and need for flow modelling*	*Car-following model, Basic terms and notations*	*Definitions - Capacity, Level of Service(LoS)*	*Various traffic measures for interrupted flow*	*Applications of control measures*
S-2	SLO-1	*Fundamental parameters - speed, density, volume,travel time,headway, spacing*	*Concept of stimulus - response*	*Highway capacity*	*Traffic signs*	*Traffic signal - elements*
	SLO-2	*Time-Space diagram*	*Application of stimulus response theory in traffic flow modelling*	*Factors affecting LoS*	*Types and specifications*	*Definition and analysis of saturation headway, saturation flow, lost time*
S-3	SLO-1	*Fundamental relations - time mean speed, space mean speed and their relation,*	*General motor's models*	*HCM methods*	*Road markings - longitudinal marking*	*Phase design - two, three, four phases*
	SLO-2	*Numerical problems and solutions*	*Derivation - general motor model*	*Urban Street - Classification*	*Road markings - transverse and object marking*	*Cycle time determination - Green split time*
S-4	SLO-1	*Relation between speeds, flow, density,*	*Simulation Problem in general motor model*	*Operational Performance measures*	*Channelization*	*Definitions and measurement of stopped and control delay*
	SLO-2	*Fundamental diagrams*	*Simulation Problem in general motor model*	*Congestion Management*	*Case studies*	*Webster's delay model*
S-5	SLO-1	*Greenshield's model – Assumptions and model form*	*Simulation Problem in general motor model*	*Case studies for congestion management*	*Traffic rotary*	*Problems in traffic signal design*
	SLO-2	*Derivation -greenshield model*	*Simulation Problem in general motor model*	*Case studies for congestion management*	*Conflict resolution in a rotary*	*Capacity and LoS analysis*
S-6	SLO-1	*Numerical solution - Greenshield model*	*Vehicle arrival model,Poisson distribution*	*Multilane highways - Characteristics, Capacity*	*Geometric layout*	*HCM 2000 method - analysis of a signalized intersections*
	SLO-2	*Numerical solution - Greenshield model*	*Problems in Poisson distribution*	*Multilane highways - Level of service*	*Design elements of rotary*	*Determination of level of service as per HCM 2000*
S-7	SLO-1	*Greenberg's logarithmicmodel*	*Headway modeling*	*Freeway operations*	*Capacity of rotary*	*Signal coordination- concepts*
	SLO-2	*Underwood's exponential model*	*Random vehicle generation*	*Freeway operations- operational considerations*	*Problem in rotary capacity*	*Application of coordinated traffic signal*

S-8	**SLO-1**	*pipe'sgeneralized model*	*Microscopic traffic simulation*	*Capacity and Level of service of freeway segment*	*Grade separated intersection - road over bridges*	*Concept of offset*
	SLO-2	*multi-regime models*	*Microscopic traffic simulation*	*Capacity and Level of service of freeway segment*	Underpass, Overpass concepts	Common cycle length andbandwidth
S-9	**SLO-1**	*Movingobserver method.*	*Design, calibration, validation, applications,*	*Weaving operation*	*Types of interchanges based on the traffic flow*	*Offset for one-way and two-way streets*
	SLO-2	*Numerical solution - moving observer method*	*Operational models.*	*Weaving operation*	*Case studies on interchanges*	*Vehicle actuated signals*

Learning Resources	1. *Roess, R. P. McShane, W. R. &Prassas, E. S. (1998), Traffic Engineering, Prentice – Hall.* *2. May, A. D. (1990), "Fundamentals of Traffic Flow", second edn, Prentice Hall.* *3. Papacostas, C. S. (1987), "Fundamentals of Transportation Engineering", Prentice-Hall, India*	*4. Kadiyali, L. R. (1987), "Traffic Engineering and Transportation Planning", KhannaPublishers, India.* *5. Papacostas, C. S. and Prevedouros, P.D. (2001) "Transportation Engineering and Planning", Prentice Hall of India Pvt. Ltd.* *6. Highway Capacity Manual (2010), Transportation Research Board, USA* *7. NPTEL link* - https://nptel.ac.in/downloads/105101008/# (as on 05.07.2019)

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of Assignments, Seminars, Tech Talks, Mini Projects, Case Studies, Self Study, MOOCs, Certifications, Conference Paper

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com	*Dr. VenkaiahChowdary, Associate Professor, NITW, vc@nitw.ac.in*	*Dr. A. Padma Rekha, SRM IST*
Mr.AnkitPachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org	*Dr. V Sunitha, Assistant Professor, NITT, sunitha@nitt.edu*	*Mr. G. Sivaprakash, SRM IST*

Course Code	18CEE315T	Course Name	SURFACE HYDROLOGY	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Create insights into various hydrometeorological variables and components of hydrological cycle			
CLR-2 :	Address concepts related to precipitation and water losses			
CLR-3 :	Analyze concepts of runoff and hydrograph analysis			
CLR-4 :	Address concepts related to floods and their estimation			
CLR-5 :	Create insights into reservoir routing and stream flow routing			
CLR-6 :	Address various types of models and their processes			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level o	Expected Pro	Expected Attain
CLO-1 :	Identify various hydrometeorological variables and components of hydrological cycle	2	85	80
CLO-2 :	Analyze precipitation and water losses	3	85	75
CLO-3 :	Understand runoff and hydrograph analysis	3	85	75
CLO-4 :	Analyze floods and their estimation	2	85	80
CLO-5 :	Understand reservoir routing and channel routing	2	80	75
CLO-6 :	Analyze various models and their processes	3	85	75

Program Learning Outcomes (PLO)																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
Engineering K	Problem Anal	Design & Dev	Analysis	Modern Tool	Society & Cul	Environment	Ethics	Indiv	Communica	Project Mgt.	Life Long L	PSO - 1	PSO - 2	PSO - 3		
H	H	-	-	-	-	-	-	-	-	-	-	H	-	-		
H	H	-	-	-	-	-	-	-	-	-	-	H	-	-		
H	H	-	-	-	-	-	-	-	-	-	-	H	-	-		
H	H	-	-	-	-	-	-	-	-	-	-	H	-	-		
H	H	-	-	-	-	-	-	-	-	-	-	H	-	-		
H	H	-	-	-	-	-	-	-	-	-	-	H	-	-		

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Weather and climate	Precipitation: forms and types	Runoff, components of stream flow	Floods: Standard project flood, maximum probable flood, PMP, design flood	Systems and models – system concept in hydrology
	SLO-2	Scope of hydrometeorology	Test for consistency of the record, causes of inconsistency in the record	Catchment characteristics, watershed concepts	Estimation of peak flood: Empirical flood formulae- Dickens, Ryves, Inglis, Myers	Types of models – physical, conceptual, empirical, mathematical models
S-2	SLO-1	Meteorological variables	Double mass curve techniques	Classification of streams, isochrones	Rational method and concentration time method	Life cycle of a model
	SLO-2	Temperature, atmospheric pressure	Depth-Area relationship, Intensity-Duration-Frequency (IDF) curves	Factors affecting runoff	Problems on peak discharge	Types of mathematical models
S-3	SLO-1	Atmospheric humidity	Analysis of rainfall data	Runoff estimation: rational method, assumptions and drawbacks	Flood frequency studies: California method and Weibull method	Formulation of a mathematical model – modeling concepts
	SLO-2	Simple problems on saturation vapour pressure and relative humidity	Problems on mean, median and mode, mass curve, hyetograph, moving average, IDF and frequency curve	Components of streamflow hydrograph	Problems on flood frequency	Watershed–System concept
S-4	SLO-1	Clouds: categories and its classification	Design storm	Baseflow separation methods	Encounter probability: probability of exceedance and Probability of non-exceedance	Types of watershed models
	SLO-2	Atmosphere: different strata of atmosphere	Water losses	Problems on rainfall excess estimation by baseflow separation methods	Problems on encounter probability	Models in practice for various hydrologic processes
S-5	SLO-1	Wind and wind belts	Evaporation from water surfaces, Dalton's law of evaporation	Derivation of a unit hydrograph	Flood routing: Reservoir routing and channel routing	Stochastic model: space independent and space co-related
	SLO-2	Evaporation, vertical air motions	Evaporation pans: floating pans, land pan and Colorado sunken pan	Elements and propositions of unit hydrograph	Reservoir routing: ISD method	Artificial Neural Network (ANN)
S-6	SLO-1	Global distribution of water	Pan coefficient, problems on loss of water due to evaporation	Problems on unit hydrograph	Modified Pul's method	ANN activation function
	SLO-2	Water resources of India	Measures to reduce lake evaporation	Problems on unit hydrograph	Problem on reservoir routing	Network training algorithm – back propagation
S-7	SLO-1	Seasons in India	Transpiration, transpiration ratio and evapotranspiration	S-curve method	Problem on reservoir routing	Advantages and limitations of ANN
	SLO-2	Hydrology and hydrologic cycle	Consumptive use determination by Blaney-Criddle method, problems.	Problems on S-curve hydrograph	Stream flow routing: prism storage and wedge storage	Fuzzy sets and fuzzy logic

S-8	SLO-1	*Distribution of rainfall in India*	*Infiltration, Horton's equation*	*Problems on S-curve hydrograph*	*Muskingum method*	*Fuzzification, evaluation of rules, defuzzification*
	SLO-2	*Scope of hydrology*	*Measurement of infiltration: infiltrometer and rainfall simulator*	*Synthetic unit hydrograph*	*Problem on Muskingum method*	*Fuzzy rule based reservoir operation model*
S-9	SLO-1	*Hydrological data*	*Infiltration indices: phi index and W-index*	*Snyder's method*	*Problem on Muskingum method*	*Changes in climate as related to water*
	SLO-2	*Hydrologic equation, simple problems on water budget.*	*Problems on Horton's equation and infiltration indices*	*Problems on Snyder's method*	*Flood forecasting and warning*	*Impacts and responses – climate change and water resources*

Learning Resources	1. *Raghunath, H.M., Hydrology, New Age International Publishers, New Delhi, 2007.* 2. *Subramanya, K., Engineering Hydrology, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 2014* 3. *Pukh Raj Rakhecha and Vijay P. Singh, Applied Hydrometeorology, Capital Publishing Company, 2009.* 4. *Chow, V.T., and Maidment, Hydrology for Engineers, McGraw Hill Inc., Ltd., 2000* 5. *Vedula, S., and Mujamdar, P.P., Water Resources Systems, McGraw Hill Inc., 2005*	6. *NPTEL Course – Advanced Hydrology: https://nptel.ac.in/courses/105101002/#* 7. *Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., 2008: Climate Change and Water. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210 pp.* 8. *NPTEL course – Watershed Management: https://nptel.ac.in/courses/105101010/16*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Abdul Hakeem, National Remote Sensing Center, Hyderabad, abdulhakeem_k@nrsc.gov.in	*1. Dr. Rehana Shaik, IIIT, Hyderabad, rehana.s@iiit.ac.in*	*1. Dr. R. Sathyanathan, SRMIST*
2. Dr. Sat Kumar Tomer, Satyukt Analytics Pvt Ltd., Bengaluru, sat@satyukt.com	*2. Dr. S. Saravanan, NIT Trichy, saravanans@nitt.edu*	*2. Dr. Deeptha Thattai, SRMIST*

Course Code	18CEE313T	Course Name	DESIGN OF HYDRAULIC STRUCTURES AND IRRIGATION ENGINEERING	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Provide knowledge on irrigation and its types, and on water movement through soil			
CLR-2 :	Expound on the design principles of gravity and earthen dams and associated structures			
CLR-3 :	Introduce diversion structures and their design by applying failure concepts			
CLR-4 :	Provide an understanding of canal structures			
CLR-5 :	Address concepts on sediment movement			
CLR-6 :	Introduce design concepts for various types of canals			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level o	Expected Pro	Expected Attain	Program Learning Outcomes (PLO)														
					1 Engineering K	2 Problem A	3 Analysis	4 Design & Dev	5 Analysis	6 Modern Tool	7 Society & Cul	8 Environment	9 Ethics	10 Individu	11 Communica	12 Project Mgt.	13 Life Long L	14 PSO - 1	15 PSO - 2	PSO – 3
CLO-1 :	Acquire knowledge on soil–plant–water relationship	2	85	80	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-	
CLO-2 :	Complete a design for dams and spillways	2	85	75	H	H	-	H	-	-	-	-	-	-	-	-	H	-	-	
CLO-3 :	Understand the types of diversion structures and design them by applying failure concepts	2	85	75	H	H	-	H	-	-	-	-	-	-	-	-	H	-	-	
CLO-4 :	Identify the various canal structures and design them	2	85	80	H	H	-	H	-	-	-	-	-	-	-	-	H	-	-	
CLO-5 :	Understand basic concepts of sediment movement	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-	
CLO-6 :	Design various types of canals considering efficiency and economy	2	85	75	H	H	-	H	-	-	-	-	-	-	-	-	H	-	-	

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Irrigation**: Necessity and importance of irrigation*	*Lane's weighted creep theory*	*Earthen dams – types*	*Canal falls – necessity and location of falls*	*Computing the design capacity of an irrigation canal*
	SLO-2	*Methods of irrigation*	*Design of a vertical drop weir on Bligh's creep theory*	*Design of earthen dams*	*Types of canal falls*	*Shield's entrainment method*
S-2	SLO-1	*Methods of improving soil fertility*	*Design of a vertical drop weir on Bligh's creep theory*	*Design of earthen dams*	*Design of a trapezoidal notch fall*	*Design of non-scouring stable channels with protected side slopes in alluvium soil (Shield's entrainment method)*
	SLO-2	*Standards of quality for irrigation water*	*Khosla's method – flow nets*	*Seepage analysis in earthen dams*	*Design of a trapezoidal notch fall*	*Design of non-scouring stable channels with protected side slopes in alluvium soil (Shield's entrainment method)*
S-3	SLO-1	*Duty and delta – factors affecting duty*	*Khosla's method of independent variables for determination of pressures and exit gradient for seepage below a weir or a barrage*	*Seepage analysis in earthen dams*	*Design of simple vertical drop fall*	*Design of non-scouring channels with unprotected side slopes in alluvium soil*
	SLO-2	*Methods of improving duty*	*Design problem on Khosla's method of independent variables*	*Design for stability of earthen dams*	*Design of simple vertical drop fall*	*Design of non-scouring channels with unprotected side slopes in alluvium soil*
S-4	SLO-1	*Irrigation efficiencies*	*Design problem on Khosla's method of independent variables*	*Design for stability of earthen dams*	*Design of a Sarda fall*	*Design of most efficient channel section*
	SLO-2	*Problems in irrigation efficiencies*	*Complete design of weir/barrage using Khosla's theory*	*Spillways – types and design considerations*	*Design of a Sarda fall*	*Design of most efficient channel section*
S-5	SLO-1	*Estimation of consumptive use –Blaney Criddle method*	*Complete design of weir/barrage using Khosla's theory*	*Design of chute spillway*	*Cross drainage works – types*	*Design of stable channels – Kennedy's theory*
	SLO-2	*Pan evaporation method – Penman's method*	***Storage structures**: Gravity dam – cross section of gravity dam*	*Design of chute spillway*	*Cross drainage works – selection of suitable type*	*Design of stable channels – Kennedy's theory*
S-6	SLO-1	*Classes and availability of soil water – soil moisture deficiency*	*Modes of failure of gravity dam*	*Design of ogee spillway*	*Design considerations for cross drainage works*	*Design of stable channels – Lacey's theory*
	SLO-2	*Depth of water stored in root zone*	*Criteria for structural stability of gravity dam*	*Design of ogee spillway*	*Design considerations for cross drainage works*	*Design of stable channels – Lacey's theory*

S-7	**SLO-1**	*Limiting soil moisture conditions*	*Design considerations for gravity dam*	*Energy dissipators*	*Design of cross drainage works*	*Balancing depth of canals*
	SLO-2	*Depth and frequency of irrigation*	*Design considerations for gravity dam*	*Design of stilling basin*	*Design of cross drainage works*	*Balancing depth of canals*
S-8	**SLO-1**	***Diversion structures**: Weirs and barrages*	*Design of gravity dam*	***Canal structures**: Canal regulators – head and cross regulator*	*Design of cross drainage works*	*Economic justification of canal lining for unlined canals*
	SLO-2	*Diversion head works and its components*	*Design of gravity dam*	*Functions – Alignment of the off-taking channel*	*Design of cross drainage works*	*Economic justification of canal lining for unlined canals*
S-9	**SLO-1**	*Failure of hydraulic structures – failure by piping and failure by direct uplift*	*Design of gravity dam*	*Design of cross regulator*	***Conveyance**: Mechanics of sediment transport*	*Design of lined canals*
	SLO-2	*Bligh's creep theory*	*Design of gravity dam*	*Design of distributary head regulator*	*Computing the design capacity of an irrigation canal*	*Design of lined canals*

Learning Resources	1. *Santhosh Kumar Garg, "Irrigation Engineering and Hydraulic Structures",Khanna Publishers, 2000.* 2. *Punmia B.C. et al., "Irrigation and Water Power Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2009* 3. *AsawaG. L., "Irrigation and Water Resources Engineering", New Age International Publishers, New Delhi, 2005.*	4. *SharmaR.K., "Irrigation Engineering and Hydraulic Structures", Oxford and IBH Publishing Company, New Delhi, 2002* 5. *NPTEL – Irrigation and Drainage:https://nptel.ac.in/courses/126105010/* 6. *NPTEL – Water Resources Engineering: https://nptel.ac.in/downloads/105105110/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, MOOCs, Certifications, and Conf. Paper etc.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Abdul Hakeem, National Remote Sensing Center, Hyderabad, abdulhakeem_k@nrsc.gov.in	*1. Dr. Rehana Shaik, IIIT, Hyderabad, rehana.s@iiit.ac.in*	*1. Dr. DeepthaThattai, SRMIST*
2. Dr. Sat Kumar Tomer, Satyukt Analytics Pvt Ltd., Bengaluru, sat@satyukt.com	*2. Dr. S. Saravanan, NIT Trichy, saravanans@nitt.edu*	*2. Dr. R. Sathyanathan, SRMIST*

Course Code	18CEE314T	Course Name	GROUND WATER ENGINEERING	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book/Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Create insights into the occurrence and properties of groundwater			
CLR-2 :	Address concepts related to movement of groundwater			
CLR-3 :	Create insights on well hydraulics			
CLR-4 :	Address concepts related to exploration and investigation of groundwater			
CLR-5 :	Create insights into groundwater management and seawater intrusion			
CLR-6 :	Understand the software applications in groundwater modeling			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level o	Expected Pro	Expected Attain	Program Learning Outcomes (PLO)														
					1 Engineering K	2 Problem A	3 Design & De	4 Analysis	5 Modern Tool	6 Society & Cu	7 Environment	8 Ethics	9 Indiv	10 Communica	11 Project Mgt.	12 Life Long L	13 PSO - 1	14 PSO - 2	15 PSO - 3
CLO-1 :	Understand the various properties of groundwater	2	85	80	H	M	L	L	-	L	H	-	-	-	-	L	M	-	-
CLO-2 :	Understand the governing equations of groundwater movement	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-3 :	Acquire the knowledge on yield of the well and its hydraulics	2	80	75	H	H	M	M	-	L	H	-	-	-	-	L	M	-	-
CLO-4 :	Understand the concept of various methods of exploration	2	85	75	H	L	M	M	-	-	H	-	-	-	-	-	M	-	-
CLO-5 :	Understand the concept of seawater intrusion and conjunctive use	2	85	80	H	M	H	H	-	M	M	-	-	-	-	L	M	-	-
CLO-6 :	Acquire knowledge on groundwater modeling and models in use	2	80	75	H	H	H	H	H	M	H	-	-	-	-	H	M	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Introduction to Groundwater***: *Global distribution of water, role of groundwater in hydrological cycle*	***Groundwater Movement*** *Groundwater Movement- Governing Equation*	***Well Hydraulics*** *Flow into a well*	***Subsurface Exploration*** *Objective and Need for exploration Various methods*	***Groundwater Management and Modeling*** ***Groundwater quality and Contamination***
	SLO-2	*Various water bearing formations, subsurface water distribution*	*Darcy's Law*	*Steady radial flow into a well: Dupuit equation, Thiem's equation*	*Geophysical investigations*	*Groundwater quality standards*
S-2	SLO-1	*Aquifers and types of aquifers*	*Heterogeneity and anisotropy*	*Unsteady radial flow into a well: Theis equation*	*Surface geophysical techniques*	*Types and sources of groundwater contamination*
	SLO-2	*Aquifer properties: porosity, permeability, specific yield, storage coefficient and transmissivity, factors affecting permeability*	*Estimation of aquifer parameters*	*Jacob's correction for very thin aquifers with water table condition*	*Electrical resistivity method*	*Various quality parameters and its significance*
S-3	SLO-1	*Problems on aquifer properties*	*Problems on Darcy's law*	*Problems on Theis equation*	*Seismic refraction method*	*Attenuation of groundwater quality*
	SLO-2	*Problems on aquifer properties*	*Problems on aquifer parameter estimation*	*Problems on Jacob equation*	*Remote sensing in groundwater exploration*	*Potential evaluation of groundwater quality*
S-4	SLO-1	*Groundwater fluctuation*	*1D governing equation of flow through porous medium*	*Theis recovery, well hydraulics*	*Other surveying methods*	*Physical, chemical and biological method of analysis*
	SLO-2	*Groundwater balance and budgeting*	*2D governing equation of flow through porous medium*	*Wells in leaky aquifer*	*Borehole geophysical techniques*	*Problems on quality evaluation*
S-5	SLO-1	*Problems on water balance equation*	*Equation for flow into leaky aquifer*	*Partially penetrating wells*	*Electric logging, radioactive logging*	*Conjunctive use of groundwater and basin management*
	SLO-2	*Problems on groundwater fluctuation*	*Flow through unconfined aquifer*	*Image well theory, multiple wells*	*Induction, fluid and sonic logging*	*Groundwater development under various scales*
S-6	SLO-1	*Groundwater in different rocks*	*Boundary conditions*	*Well capacity and well development*	*Geochemical method of exploration*	*Groundwater modeling, problems in groundwater*
	SLO-2	*Groundwater potential in India*	*Groundwater flow rates and direction*	*Construction and types of open well*	*Application of GIS in groundwater exploration*	*Types of models*
S-7	SLO-1	*Case Study 1*	*Groundwater flow problems*	*Construction and types of tube well*	*Seawater intrusion theory*	*Conceptual model, physical model*
	SLO-2	*Case Study 2*	*Steady one dimensional flow, flow into galleries*	*Problems on well hydraulics*	*Shape of interface*	*Mathematical model and analog model*

S-8	**SLO-1**	*GEC Norms*	*Aquifer with recharge*	*Problems on Theis recovery*	*Slope of interface*	*Data, input, boundary conditions and output, prediction*
	SLO-2	*Methodology of estimation*	*flow into confined aquifer with constant*	*Pumping test and recuperation test*	*Causes of seawater intrusion*	*Calibration and validation of a model*
S-9	**SLO-1**	*Status of groundwater in various parts of India- a case study*	*flow into confined aquifer with variable thickness*	*Problems on yield test*	*Effects of seawater intrusion*	*Groundwater models*
	SLO-2	*Threats to groundwater*	*Groundwater Theory, Solution for differential Equations*	*Well losses and determination*	*Various methods of reducing seawater intrusion*	*MODFLOW, MT3D, FEFLOW, SEAWAT*

Learning Resources	*1. Raghunath, H. M., "Ground Water", New Age International (P) Ltd, 2014.* *2. D.K. Todd and L. F. Mays, "Groundwater Hydrology", John Wiley and Sons.* *3. K. R. Karanth, "Hydrogeology", Tata McGraw Hill Publishing Company.*	*4. NPTEL course - Ground Water Hydrology: http://nptel.ac.in/courses/105105042/* *5. NPTEL course - Ground Water Hydrology: http://nptel.ac.in/courses/105103026/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	18CEE310T	Course Name	SOLID AND HAZARDOUS WASTE MANAGEMENT	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	*Create insights to the various sources and classification of solid and hazardous waste*			
CLR-2 :	*Address concepts related to waste characteristics and source reduction*			
CLR-3 :	*Create insights to the* storage, collection and transport of waste			
CLR-4 :	*Address concepts related to* waste processing technologies			
CLR-5 :	*Address concepts related to waste disposal*			
CLR-6 :	*Role of Government and NGO's in sustaining the waste management*			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level of	Expected Pro	Expected Attai	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering K	Problem A	Design & D	Analysis,	Modern Tool	Society & C	Environment &	Ethics	Individ	Communica	Project Mgt. & Fi	Life Long	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*Understand the various sources of solid and hazardous waste*	2	85	80	H	H	M	L	-	L	H	-	-	-	-	L	M	-	-
CLO-2 :	*Able to identify the options for* Reduction, reuse and recycling of waste	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-3 :	*Knowledge of collection and transport of solid and hazardous waste*	2	80	75	H	H	M	M	-	L	H	-	-	-	-	L	M	-	-
CLO-4 :	*Able to know about various* waste processing techniques	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-5 :	*Understand the waste disposal methods and management*	2	85	80	H	H	M	M	L	L	M	-	-	-	-	L	M	-	-
CLO-6 :	*Knowledge of basic solid and hazardous waste legislations*	2	80	75	H	H	M	-	-	L	M	-	-	-	-	-	M	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Sources, classification and regulatory framework:* Sources of solid waste	*Waste characterization and source reduction: Waste generation rates*	*Storage, collection and transport of waste: Handling of waste at source*	*Waste processing technologies: Objectives of waste processing*	*Waste disposal : Waste disposal options for solid and hazardous waste*
	SLO-2	*Types of solid waste*	*Waste generation variation*	*Segregation of waste at source*	*material separation technologies in solid waste*	*Disposal in landfills*
S-2	SLO-1	*Hazardous Waste - Identification*	*sampling and characterization*	*Storage of municipal solid waste*	*Physical Processing Equipment*	*Landfill Classification*
	SLO-2	*Hazardous Waste -Classification*	*factors affecting waste generation rate and Composition*	*On-site storage methods*	*material processing technologies*	*Landfill types*
S-3	SLO-1	*Need for solid waste management*	*Physical properties of solid waste*	*Effect of storage*	*chemical conversion technologies*	*Landfill methods*
	SLO-2	*Need for hazardous waste management*	*Chemical properties of solid waste*	*Materials used for containers*	*biological conversion technologies methods of Composting*	*Site selection*
S-4	SLO-1	*Elements of integrated waste management*	*Biological properties of solid waste*	*Collection of municipal solid waste- Methods*	*biological conversion technologies methods of Composting*	*Design and operation of sanitary landfills*
	SLO-2	*roles of stakeholder's*	*Hazardous Characteristics*	*Collection vehicles – Manpower – Collection routes*	*Factors of Composting*	*Landfill liners*
S-5	SLO-1	*Role of public and NGO's*	*TCLP tests*	*Analysis of Collection systems*	*Thermal conversion technologies- energy recovery*	*Secure landfills*
	SLO-2	*Tutorial 1: Case Study: Status of Waste Generation in Bangalore*	*Tutorial 3 : Practices in household waste management*	*Solving problems using Tutorial Sheet 7*	*Thermal conversion technologies- energy recovery*	*Landfill bioreactors*
S-6	SLO-1	*Public health and environmental impacts*	*Tutorial 4: Source Reduction and Recycling.*	*Need for transfer and transport*	*Incineration*	*Leachate management*
	SLO-2	*Salient features of Indian legislations on management and handling of municipal solid waste*	*Source reduction of waste*	*Transfer stations*	*Hazardous Waste Treatment*	*Landfill gas management*

S-7	SLO-1	*Hazardous waste*	*Waste exchange*	*Hazardous Waste-Storage and collection*	*Physical and chemical treatment*	*Landfill closure*
	SLO-2	*Biomedical waste*	*Extended producer responsibility*	*Hazardous Waste-Storage and collection*	*Thermal treatment*	*Environmental monitoring*
S-8	SLO-1	*Lead acid batteries*	*Recycling*	*Hazardous Waste -Transfer and transport*	*Biological treatment*	*Rehabilitation of open dumps*
	SLO-2	*Electronic waste*	*Reuse*	*Hazardous Waste -Transfer and transport*	*Pollution Prevention and Waste Minimization*	*Landfill remediation*
S-9	SLO-1	*Plastics and fly ash*	*Solving problems using Tutorial Sheet 5*	*Hazardous waste manifests*	*Hazardous Wastes Management in India*	*Solving problems using Tutorial Sheet 9*
	SLO-2	*Tutorial 2: Mention the public awareness program*	*Solving problems using Tutorial Sheet 6*	*Hazardous waste transport*	*Solving problems using Tutorial Sheet 8*	*Solving problems using Tutorial Sheet 10*

Learning Resources	*1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.* *2. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management, Hazardous waste Management, Mc-Graw Hill International edition, New York, 2001.*	*3. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2000.* *4. NPTEL Course-Municipal solid waste management : https://nptel.ac.in/courses/120108005/* *5. NPTEL Course-Solid and Hazardous waste management : https://nptel.ac.in/courses/105106056/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*60%*	-	*60%*	-	*60%*	-	*60%*	-	*60%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	-	-	-	-	-	-	-	-	-	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conference Paper etc.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Rajkumar Samuel, Hubert Enviro-Care Systems, Chennai, rajkumar@hecs.in	*1. Dr. E. S. M Suresh, NITTTR Taramani Chennai, esmsuresh@gmail.com*	*Mr. D. Justus Reymond, Asst.Prof, SRMIST*
2. Mr. A. Abdul Rasheed, CMWSS Board, juruterarasheed@gmail.com	*2. Dr. G. Dhinagaran, Asst. Professor, CES, Anna University, twinsdina@gmail.com*	*Mr. S. Dhanasekar, Asst.Prof, SRMIST*

Course Code	18CEE311T	Course Name	AIR AND NOISE POLLUTION AND CONTROL	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Create insights to the various sources ofair quality			
CLR-2 :	Address concepts related to modeling of atmospheric pollutants			
CLR-3 :	Create insights to the air and noise pollution monitoring techniques			
CLR-4 :	Address concepts related to reduce air pollution			
CLR-5 :	Address concepts related to reduce noise pollution			
CLR-6 :	Role of Government and NGO's in sustaining the air pollution at the source			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level of	Expected Pro	Expected Attai	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering K	Problem Ana	Design & Deve		Modern Tool	Society & Cu	Environment &	Ethics	Indivi	Communica	Project Mgt. & Fi	Life Long	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Understand the various sources of air and noise pollution	2	85	80	H	H	M	L	-	L	H	-	-	-	-	L	M	-	-
CLO-2 :	Able to analyze air quality parameters	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-3 :	Knowledge of atmospheric transport models for air pollutants	2	80	75	H	H	M	M	-	L	H	-	-	-	-	L	M	-	-
CLO-4 :	Able to identify techniques to reduce noise pollution	2	85	75	H	H	H	H	-	-	H	-	-	-	-	-	M	-	-
CLO-5 :	Apply the concept of reducing air and noise pollution	2	85	80	H	H	M	M	L	L	M	-	-	-	-	L	M	-	-
CLO-6 :	Knowledge of basic environmental legislations related to air and noise pollution	2	80	75	H	H	M	-	-	L	M	-	-	-	-	-	M	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction	Sources, classification and effects	Sampling and Meteorology	Air Pollution Control Measures	Noise pollutionand its control
	SLO-2	Air pollutants, Sources, classification,	Ambient air quality and emission standards	Ambient air sampling	Basics of pollution control	Basics of acoustics and specification of sound;
S-2	SLO-1	Monitoring techniques for air and noise pollution	Air pollution indices.	pollution measurement methods,	Control equipments –	sound power, sound intensity and sound pressure levels;
	SLO-2	Combustion Processes and pollutant emission,	Natural sources	principles and instruments	Particulate control methods	plane, point and line sources, multiple sources;
S-3	SLO-1	Air Act, legislation and regulations	Type of air pollutants	Monitoring stations in India	settling chambers,	outdoor and indoor noise propagation;
	SLO-2	Air quality management in India.	Effects on Health, vegetation-	temperature lapse rate and stability	cyclone separation,	psychoacoustics and noise criteria,
S-4	SLO-1	Greenhouse effect.	-materials and atmosphere	Adiabatic lapse rate	Wet collectors	effects of noise on health, annoyance rating schemes;
	SLO-2	Urban heat island	Reactions of pollutants in the atmosphere and their effects	Wind Rose, Inversion	fabric filters	special noise environments
S-5	SLO-1	Major contributions of air pollutant	-Smoke, smog and ozone	Wind velocity and turbulence	electrostatic precipitators	Infrasound, ultrasound, impulsive sound and sonic boom;
	SLO-2	Noise -What is Noise?	Layerdisturbance,	Plume behavior	Removal of gaseous pollutants by adsorption, absorption,	
S-6	SLO-1	Noise pollution,	Ambient noise quality and emission standards	Carbon emission	Biological air pollution control technologies,	noise standards and limit values;
	SLO-2	Sources, classification,	Noise pollution indices.	Noise sampling and Noise level meter	Indoor air quality	Occupational noise standard
S-7	SLO-1	Monitoring techniques for noise pollution	Manmade sources	Pollution measurement methods,	control principles	Noise instrumentation and monitoring procedure.
	SLO-2	Noise Act, legislation and regulations	Types of noise pollutant	Principles and instruments	Alternative	Noise indices.

S-8	SLO-1	*Noise quality management in India.*	*Effects on Human Health and*	*Occupational noise monitoring*	*Case studies on Air pollution -1*	*Noise control methods*
	SLO-2	*Noise management in other countries*	*O0occupational exposure*	*Monitoring-case studies*	*Case studies on Air pollution -1*	*Case studies on Air pollution– 2*
S-9	SLO-1	*Solving problems using Tutorial Sheet 1*	*Solving problems using Tutorial Sheet 3*	*Tutorial hour-1*	*Tutorial hour-3*	*Case studies on noise pollution*
	SLO-2	*Solving problems using Tutorial Sheet 2*	*Solving problems using Tutorial Sheet 4*	*Tutorial hour-2*	*Tutorial hour-4*	*Case studies on noise pollution*

Learning Resources	1. *C. S. Rao, "Environmental Pollution Control Engineering", Wiley Eastern Limited, 2000.* 2. *M. N. Rao, H. V. N. Rao, Air pollution, Tata McGraw Hill Pvt Ltd, New Delhi, 1993* 3. *Dr. Y. Anjaneyulu, "Air Pollution and Control Technologies", Allied publishers Pvt. Ltd., 2002.* 4. *Noel De Nevers, "Air pollution control Engineering", McGraw Hill International Edition* 5. *Peterson and E.Gross Jr., "Hand Book of Noise Measurement", 5 th Edition, 1963*	6. *Mukherjee, "Environmental Pollution and Health Hazards", causes and effects, 1986* 7. *Antony Milne, "Noise Pollution: Impact and Counter Measures", David & Charles PLC, 1979.* 8. *Kenneth wark, Cecil F.Warner, "Air Pollution its Origin and Control", Harper and Row Publishers* 9. *NPTEL Online Course - Noise Management and Control :* https://swayam.gov.in/nd1_noc19_me72/

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*60%*	-	*60%*	-	*60%*	-	*60%*	-	*60%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	-	-	-	-	-	-	-	-	-	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Elvis Dsouza, EDPC Polymer Industries, Maharashtraelvisdsouza11@gmail.com	*Dr. Rehana Shaik, Assiatant Professor, Dept of Civil Engineering, IIIT Hyderbad rehanaiisc@gmail.com*	*Dr. Paromita Chakraborty, Research Assoc.Professor, SRMIST*
Dr.Rajkumar Director Hubert Envirocare Systems, Chennai rajkumar@hecs.in	*Dr. E.S.M Suresh Professor & Head Department of Civil Engineering NITTTR, Chennaiesmsuresh@gmail.com*	*Mr. S.Ramesh, Assist. Prof & Mr.K.C. Vinuprakash, Assist. Prof. SRMIST*

Course Code	18CEE312T	Course Name	ENVIRONMENTAL IMPACT ASSESSMENT AND LIFE CYCLE ANALYSIS	Course Category	E	Professional Elective Courses	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Know the interrelationship between various activities and their impact on environment			
CLR-2 :	Understand how to conduct an environmental impact assessment			
CLR-3 :	Learn principles and methods of environmental analysis			
CLR-4 :	Know how to review and comment on an environmental impact statement, environmental assessment and environmental regulations			
CLR-5 :	Understand role of standards and how government, NGOs, and the private sector can affect their evolution			
CLR-6 :	Explain the concept of life cycle assessment (LCA) as an environmental management tool and its potential for identifying all the environmental impacts throughout the entire life cycle of a product			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level of	Expected Pro	Expected Attai	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering K	Problem Anal	Design & Dev	Analysis	Modern Tool	Society & Cul	Environment & Sust	Ind	Communica	Project Mgt. & Fi	Life Long	PSO - 1	PSO - 2	PSO - 3	
CLO-1 :	Explainkey concepts in environmental impact assessment & Management	3	85	80	H	-	-	-	-	-	H	H	-	-	-	-	M	-	-
CLO-2 :	Understand the importance of various rules & regulation in EIA	2	85	75	-	M	-	-	-	M	H	-	-	-	-	-	M	-	-
CLO-3 :	Evaluate the Impact on various environments and role of stake holders in EIA	2	80	75	H	M	-	M	-	M	M	-	-	-	-	-	M	-	-
CLO-4 :	Explain the application of Life cycle analysis	2	85	75	H	M	-	-	-	H	H	M	-	-	-	-	M	-	-
CLO-5 :	Identify most suitable tool for assessment process and make suggestions for solutions	2	85	80	H	H	-	M	M	-	M	M	-	-	-	-	M	-	-
CLO-6 :	Participate in a group to evaluate a project using EIA & LCA using one or more management tools	2	80	75	H	H	-	M	-	-	H	-	H	-	-	-	H	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Introduction*** *Introduction, definitions and concepts of EIA, ethics and environment, EIA for civil engineers*	***Evolution of EIA*** *Evolution of EIA worldwide; Evolution of EIA in India; Forecasting Environmental Changes*	***Assessment Technique*** *Components of the Environment: Water- Standards pertaining to water quality*	***Life Cycle Analysis*** *Life cycle assessment and its purpose; Evolution of Life Cycle Assessment; Stages in LCA of a Product; A Code of Good Conduct for LCA*	***EIA Methodologies*** *Initial Environmental Examination; Screening*
	SLO-2	*Discussion: Identify the ethics that you breach in daily activities which affects the environment*	*Discussion: Introduction to importance of Rio Convention*	*Activity & Discussion using a Case Study*	*Discussion: Necessary for LCA*	*Case Study involving screening*
S-2	SLO-1	*Ecology and the environment ; Ecosystem and its characteristics*	*Types of EIA: Rapid; Comprehensive; Strategic; Sectoral; Regional Rationale and scope of each type*	*Components of the Environment: Air & Noise- Standards pertaining to Air & Noise quality*	*Procedures for LCA; Defining the goal and scope; Analyzing the inventory; Assessing environmental impact*	*Scoping Analysis of alternatives*
	SLO-2	*In continuation with previous class discussion in how the ecosystem in which you live gets affected your activities*	*Case Study*	*Activity & Discussion using a Case Study*	*Case Study using LCA*	*Case Study in EIA*
S-3	SLO-1	*Structure of Ecosystem; Biotic Components Abiotic components*	*EIA Regulations in India Overview of Indian laws – Constitutional Provisions (Water, Air, Forest, Hazardous etc)*	*Components of the Environment: Soil- Soil quality, Landuse Criteria*	*Carbon trading: Energy foot printing, Food foot printing and Carbon foot printing.*	*Mitigation- Definition, options for mitigation of impact on water, air and land, water, energy, flora and fauna*
	SLO-2	*Identify the impact of your activities on Biotic and abiotic components of your ecosystem& How their services gets affected*	*Discussion: Evolution of law with time*	*Activity & Discussion using a Case Study*	*Case Study On carbon footprint*	*Case study Employing mitigation measures*
S-4	SLO-1	*Food chains, Food webs and Tropic levels*	*EPA 1986*	*Components of the Environment: Biosphere (Macro, Micro)- Introduction to Hazard Exposure levels for biota*	***Environmental management:*** *Principles, problems and strategies; Review of political, ecological and remedial actions.*	*Environmental Impact Statement- Document planning - collection and organization of relevant information*

	SLO-2	*Identify the impact of your activities on various trophic levels of your ecosystem*	*Discussion: Amendment of E(P) Rules, 1986 on time of 545 days for finalisation of Draft Notification (MOEFCC Website)*	*Activity & Discussion using a Case Study*	*Discussion With Activity: Why Environmental Management is important – using case study*	*Example: Case study with Documentation*
S-5	SLO-1	*Energy and energy flows; Elemental cycles,*	*EIA Notification 2006*	*Components of the Environment: Socio-economic*	*Environmental audit: Definitions and concepts, partial audit, compliance audit, methodologies and regulations.*	*ToR& Sectoral ToR*
	SLO-2	*Choose a element cycle and how it affects the ecosystem*	*Case Study*	*Activity & Discussion using a Case Study*	*Discussion: Introduction to ISO 19011 (EMS Auditing)*	*Example of ToR for various environments*
S-6	SLO-1	*Concept of Succession;Role of succession in restoration and recovery of ecosystem*	*CPCB and State PCBs – roles and responsibilities*	*Components of the Environment: Cultural and Aesthetics*	*Local infrastructure development and environmental management: A system approach, Regional environmental management system Landuse Conversion plan development and implementation strategies*	*Environmental Assessment- Base line, Construction Phase, Post Construction/ Operational phase scenario*
	SLO-2	*Example: Restoration of an ecosystem (Mining area)*	*Discussion: Sethusamudram Project- Role of CPCB& SPCB and Central & State Governments*	*Activity & Discussion using a Case Study*	*Discussion: Problems faced in developmental projects- using case study*	*Case study on a project*
S-7	SLO-1	*Ecosystem disturbances and their causes; natural causes and anthropogenic causes*	*Structured Environmental Management Systems ISO 14001 - EMS*	*Role of Public Participation in EIA*	*Environmental management systems in local government. Certification body assessments of EMS Documentation for EMS*	*Impact Assessment Methodologies: Checklists- Simple, Descriptive, Scaling Checklist*
	SLO-2	*Discussion: How Do Species Replace One Another in Ecological Succession?*	*Case Study: (Whitelaw and Butterworth, ISO 14001: Environmental System Handbook, 1997)*	*Reference EIA Notification 2006*	*Discussion: Expert systems (Software/ Model) used for EMS*	*Case study involving Checklist methods*
S-8	SLO-1	*Ecosystem and Ecological Footprints*	*ISO 18001- OHSAS*	*Role of stakeholders*	*Sustainable development – Definitions, Charter and Global Conventions; Future scenarios.*	*Matrix- Simple, Interaction- Leopold Matrix, Stepped matrix*
	SLO-2	*Discussion: How Cultural Changes Have Increased Our Ecological Footprints?*	*Discussion: Accreditation Procedure for ISO 14001*	*Activity & Discussion using a Case Study, Role Play*	*Discussion on various important conventions*	*Case study involving Matrix methods Discussion: Aldo Leopold's Environmental Ethics*
S-9	SLO-1	*Discussion of basic concepts*	*Environmental Risk Assessment*	*Setting the baseline*	*Case Studies on EIA*	*Network Methods Decision Tree, Expert Systems*
	SLO-2	*Example: Case study (An Affected Area)*	*Discussion: risk screening/prioritization*	*Discussion- Describe the various aspects of the environmental components of your neighborhood*	*Case Studies on EIA*	*Case study involving Network methods Introduction to various Expert system (Software/ models widely used)*

Learning Resources	*1.L. W. Canter, Environmental Impact Assessment, 2nd Ed., McGraw-Hill, 1997.* *2. G. Burke, B. R. Singh and L. Theodore, Handbook of Environmental Management and Technology, 2nd Ed., John Wiley & Sons, 2000* *3. R. Therivel, John Glasson, Andrew Chadwick, Introduction to Environmental Impact Assessment (Natural and Built Environment), Routledge, 2005.* *4. K. Whitelaw and Butterworth, ISO 14001: Environmental System Handbook, 1997*	*5.H. Scott Matthews, Chris T. Hendrickson, and Deanna Matthews, Life Cycle Assessment: Quantitative Approaches for Decisions that Matter, 2014. Open access textbook, retrieved from https://www.lcatextbook.com/* *6. NPTEL Course - Environmental Management :https://nptel.ac.in/courses/120108004/16#* *7. NPTEL Course - Environmental Impact Assessment : https://nptel.ac.in/syllabus/105103024/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*60%*	-	*60%*	-	*60%*	-	*60%*	-	*60%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	-	-	-	-	-	-	-	-	-	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Dr.Rajkumar, Director, Hubert Envirocare Systems, Chennai, rajkumar@hecs.in	*Dr. Harish Gupta,* University College of Engineering *Osmania University, Hyderabad,* harishgupta78@gmail.com	*Mr. K. Prasanna, SRMIST*

Course Code	18CEE307T	Course Name	DESIGN OF EARTHQUAKE RESISTANT STRUCTURES	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes/Standards	IS 1893 (Part 1):2016, IS 13920 : 2016		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Understand the principles of structural dynamics with regard to Single Degree Of Freedom (SDOF) system.			
CLR-2 :	Extension of understanding of SDOF system to Multi Degree Of Freedom System (MDOF) with emphasis on two degree of freedom system.			
CLR-3 :	Understand the fundamentals of earthquake forces.			
CLR-4 :	Apply structural dynamics principles to the analysis of structures subjected to earthquake forces.			
CLR-5 :	Design earthquake resistant moment resistant frames / shear walls with emphasis on ductile detailing.			
CLR-6 :	Understand the modern concepts in the design of earthquake resistant structures using isolation techniques.			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of	Expected Pro	Expected Attai	Program Learning Outcomes (PLO)															
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
					Engineering K	Problem Anal	Design & Deve	Investigati	Modern Tool	Society & Cul	Environment & Sust	Ethics	Individu	Communica	Project Mgt. & Fi	Life Long	PSO - 1	PSO - 2	PSO - 3	
CLO-1 :	Analyze single degree moment resistant frame for free and forced vibrations	3	80	80	H	H	-	H	-	-	-	-	-	-	-	-	H	-	-	
CLO-2 :	Analyze two degree moment resistant frame for free vibrations using modal superposition method	3	75	75	H	H	-	H	-	-	-	-	-	-	-	-	H	-	-	
CLO-3 :	Calculate base shear using equivalent static method as per IS 1893	3	90	85	H	H	H	H	-	-	-	-	-	-	-	L	H	-	-	
CLO-4 :	Calculate base shear using response spectrum method as per IS 1893	3	85	80	H	H	H	H	-	-	-	-	-	-	-	L	H	-	-	
CLO-5 :	Apply the provisions of IS13920 to structures	3	90	80	H	M	M	M	-	-	L	-	-	-	-	L	H	-	-	
CLO-6 :	Suggest isolation systems for earthquake resistance	3	75	75	H	L	L	L	-	-	L	-	-	-	-	-	M	-	-	

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***SINGLE DEGREE OF FREEDOM SYSTEM (SDOF)*** *Introduction to Systems with single degree of freedom*	***MULTI-DEGREE OF FREEDOM SYSTEM (MDOF)*** *Introduction to Systems with two degrees of freedom*	***DESIGN SEISMIC FORCES AS PER IS 1893-2016*** *Basis of earthquakes – epicenter*	***DUCTILE DESIGN FOR EARTHQUAKE RESISTANCE USING IS 13920-2016*** *Definition of ductility – member and structural*	***BASE ISOLATION*** *Introduction to base isolation*
	SLO-2	*Definition of free vibration – mass, stiffness,*	*Introduction to Systems with multi degrees of freedom (MDOF)*	*Magnitude of earthquake – measurement – Richter's scale*	*Response reduction factor and ductility*	*Passive base isolation – introduction*
S-2	SLO-1	*Damped and undamped vibration*	*Moment resistant frames as MDOF– two degree freedom system*	*Intensity of earthquake – different scales*	*General specification for ductility*	*Base isolation for a building*
	SLO-2	*Fundamental / Natural frequency and time period – problem solving*	*Shear building and lumped mass*	*Configurations of buildings to resist earthquake*	*Ductile requirements of beams – general*	*Purpose of base isolation*
S-3	SLO-1	*Forced vibration –Harmonic loading*	*Calculation of column stiffness – effect of orientation of column on stiffness*	*Vertical and in-plan mass irregularities*	*Ductile requirements of beams – Longitudinal reinforcement*	*Principles of base isolation*
	SLO-2	*Derivation of equation of motion for free and forced vibration*	Computation of diagonal mass matrix	*Vertical and in-plan stiffness irregularities – calculation of eccentricities in plan*	*Ductile requirements of beams – Transverse reinforcement*	*Basic requirements of base isolation system*
S-4	SLO-1	*Solution of equation of motion for free vibration*	*Computation of stiffness matrix*	*Storey drift and storey shear*	*Ductile requirements of columns – geometry*	*Type of Base Isolation Systems – Elastomeric rubber bearings – Roller and ball bearings,*
	SLO-2	*Solution of equation of motion for forced vibration – harmonic loading*	*Forming acceleration and velocity vectors*	*Response spectrum*	*Relative strength of columns and beams at a joint*	
S-5	SLO-1	*Problem solving for finding the response for undamped free vibration*	*Equation of motion of undamped two degree lumped mass free vibration of*	*Seismic zone factor, Importance factor,*	*Transverse reinforcement in column*	*Type of Base Isolation Systems – springs – sliding bearing*

			moment resistant frame			
	SLO-2	*Problem solving for finding the response for damped free vibration*	*Solution of equation of motion of undamped two degree freedom system for free vibration*	*Response reduction factor*	*Ductile detailing for shear walls – introduction*	*Modeliing base isolation in SAP – introduction*
S-6	SLO-1	*Problem solving for finding the response for undamped forced vibration*	*Eigen value problem and modal superposition method*	*Percentage of imposed loads , seismic weight of floors- Load combinations*	*General requirements*	*Input requirements for SAP*
	SLO-2	*Problem solving for finding the response for damped forced vibration*	*Determining modal frequencies and time periods*	*Introduction to Equivalent Static Method (ESM) and its limitations*	*Design for shear force*	*Input requirements for ETABS*
S-7	SLO-1	*Magnification factor*	*Uncoupled equations in SDOF and finding modal response*	*Computation of base shear for single & double storey moment resistant plane frame using ESM*	*Design for axial force*	*Modeling for base isolation in STAAD.Pro*
	SLO-2	*Application to determine the forces transferred to base from machine foundation*	*Undamped equation of motion for two degree moment resistant frame with lateral harmonic loading at the DOF*	*Introduction to Response Spectrum Method(RSM) and applicability*	*Design for bending moment*	*Input requirements for STAAD.Pro*
S-8	SLO-1	*Machine isolation*	*Modal superposition method to form uncoupled SDOF equations including modal load vector.*	*Computation of base shear for single storey and double storey moment resistant plane frame using RSM*	*Opening in walls – introduction*	*Introduction to active base isolation*
	SLO-2	*Determination of damping required to minimize forces transferred to foundation*	*Determination of response of the structure at discrete time intervals.*	*Introduction to DBE (Design Based Earthquake) and MCE(Maximum Considered Earthquake)*	*Detailing around the openings*	*Underlying principles of active base isolation*
S-9	SLO-1	*Definition of ground motion due to earthquake*	*Superposition of modal responses*	*Performance based design – Capacity and demand spectra as per ATC40*	*Ductile construction joints*	*Schematic diagram of a typical active base isolation system*
	SLO-2	*Equivalent model for considering ground motion in moment resistant fame*	*Square Root of Sum of Squares (SRSS) method.*	*Principles of pushover analysis and pushover curve*	*Ductile design of gravity columns in buildings*	*Comparison between passive and active base isolation*

Learning Resources	1. *Anil K.Chopra, "Dynamics of structures" (Theory and Applications to Earthquake Engineering), 5th Edition, Pearson, 2016* 2. *Short course on "Seismic design of reinforced concrete buildings", CEP, IIT, Kanpur, 2005.*	3. *IS 1893: 2016, (Part I) "Criteria for Earthquake Resistant Design of Structures - Part 1 :General Provisions and Buildings", BIS, 2016.* 4. *IS 13920: 2016 ,"Ductile design and detailing of reinforced concrete structures subjected to seismic forces - Code of practice", BIS, 2016.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*40 %*	-	*40 %*	-	*10 %*	-	*40%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*70 %*	-	*55%*	-
	Analyze										
Level 3	Evaluate	20 %	-	20 %	-	20 %	-	*20 %*	-	*5%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Er. S. Dhanabal, General Manager, NLY, Neyveli, dhans1960@yahoo.co.in	*1. Dr. R. Santhakumar, Professor, Centre for Rulal Department, NITTTR*	*Prof. G. Augustine Maniraj Pandian, SRMIST*
2. Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai, desigan.agv@gmail.com	*2. Dr. P. Jayabalan, NIT, Trichy, pjeya@nitt.edu*	*Dr. K.S. Satyanarayanan, SRMIST*

Course Code	18CEE308T	Course Name	DESIGN OF STEEL-CONCRETE COMPOSITE STRUCTURES	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book/Codes/Standards	IS 456 :2000, IS 800: 2007, IS 11384, Steel Tables		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Understand the concept of steel-concrete composite member design and to get introduced to the relevant IS codes			
CLR-2 :	Create insights to the concepts of Limit state method of design			
CLR-3 :	Utilize the concepts in performing design of steel-concrete composite beams and columns			
CLR-4 :	Utilize the concepts in performing design of steel-concrete composite connections			
CLR-5 :	Understand the behaviour of composite girder bridges			
CLR-6 :	Create insights to the seismic behaviour of composite structures			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level o	Expected Pro	Expected Attain	Program Learning Outcomes (PLO)														
					Engineering Kn	Problem Anal	Design & Dev	Investi	Modern Tool	Society & Cul	Environment	Ethics	Indivi	Communica	Project Mgt.	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify the effect of external loads on steel-concrete composite members and the factors influencing their behaviour and to get familiarity with the relevant IS codes	2	85	80	H	-	-	M	-	-	-	-	-	-	-	H	H	M	-
CLO-2 :	Analyze the behavior of steel-concrete composite sections under flexure, shear and compression	2	85	80	H	H	-	M	-	-	-	-	-	-	-	H	H	M	-
CLO-3 :	Apply Limit state method of design to steel-concrete composite beams and columns	2	80	75	H	H	H	H	-	-	-	-	-	-	-	H	H	M	-
CLO-4 :	Apply Limit state method of design to steel-concrete composite connections	2	80	75	H	H	-	M	-	-	-	-	-	-	-	H	H	M	-
CLO-5 :	Analyze the behavior of steel-concrete composite girder bridges	2	80	75	H	-	-	M	-	-	-	-	-	-	-	H	H	M	-
CLO-6 :	Analyze the seismic behaviour of composite structures	2	85	80	H	H	H	H	-	-	-	-	-	-	-	H	H	M	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***INTRODUCTION*** *Introduction to Steel - Concrete Composite Construction-Advantages-Limitations*	*Design Example 1*	*Design Example 3*	*Design Example 1*	***SEISMIC BEHAVIOUR OF STEEL-CONCRETE COMPOSITE STRUCTURES*** *Introduction*
	SLO-2	*Materials to be used-Structural advantages-Factors deciding selection of materials*	*Design Example 1*	***DESIGN OF CONNECTIONS*** *Introduction*	*Design Example 1*	*Basic concepts*
S-2	SLO-1	*Introduction to steel - concrete composite codes/standards*	*Design Example 2*	*Types of Connections*	*Design Example 2*	*General design criteria*
	SLO-2	*Limitations of using BIS codes-Introduction to Eurocode 4*	*Design Example 2*	*Choice of Connections in Composite structures*	*Design Example 2*	*General design criteria*
S-3	SLO-1	*Theory of composite structures*	*Design Example 2*	*Behaviour of Connections in Composite structures*	***DESIGN OF STEEL-CONCRETE COMPOSITE GIRDER BRIDGES*** *Introduction*	*Code provisions*
	SLO-2	*Behaviour of composite beams*	*Design Example 2*	*Basic concepts*	*Behaviour of girder bridges*	*Seismic behaviour of composite beams*
S-4	SLO-1	*Behaviour of composite beams*	*Design of Composite Columns*	*Code provisions*	*Behaviour of girder bridges*	*Seismic behaviour of composite beams*
	SLO-2	*Behaviour of composite columns*	*Design Procedure*	*Design procedure*	*Design concepts*	*Seismic behaviour of composite slabs*
S-5	SLO-1	*Behaviour of composite columns*	*Relevant BIS code provisions*	*Design Example 1*	*Design concepts*	*Seismic behaviour of composite slabs*
	SLO-2	*Limit state method of design of steel-concrete composite sections under flexure-code provisions*	*Choice of cross-sections*	*Design Example 1*	*Materials to be used-Types of cross-sections*	*Seismic behaviour of composite columns*
S-6	SLO-1	*Limit state method of design of steel-concrete composite sections under shear- code provisions*	*Design Example 1*	*Design Example 2*	*Basic design considerations*	*Seismic behaviour of composite columns*

	SLO-2	*Limit state method of design of steel-concrete composite sections under compression- code provisions*	*Design Example 1*	*Design Example 2*	*Basic design considerations*	*Seismic behaviour of composite connections*
S-7	**SLO-1**	***DESIGN OF STEEL-CONCRETE COMPOSITE MEMBERS*** *Design of Composite beams*	*Design Example 1*	*Design Example 3*	*Failure types*	*Seismic behaviour of composite connections*
	SLO-2	*Design Procedure*	*Design Example 2*	*Design Example 3*	*Failure types*	*Seismic behaviour of composite frames*
S-8	**SLO-1**	*Relevant BIS code provisions*	*Design Example 2*	*Design of Shear Connections*	*Relevant code provisions*	*Seismic behaviour of composite frames*
	SLO-2	*Choice of cross-sections*	*Design Example 2*	*Basic concepts*	*Mandatory checks*	*Seismic behaviour of composite frames*
S-9	**SLO-1**	*Design Example 1*	*Design Example 3*	*Code provisions*	*Comparison with conventional bridge types*	*Design methods*
	SLO-2	*Design Example 1*	*Design Example 3*	*Design procedure*	*Comparison with conventional bridge types*	*Design methods*

Learning Resources	*1. "Teaching Resource Material for Structural Steel Design", Volume 2/3 jointly prepared by 1. I.I.T., MS 2. Anna University 3. SERC, MS 4. "Institute for Steel Development and growth", Calcutta.* *2. Owens .G.W, & Knowels.P. "Steel Designs Manual", (sixth Edition) Steel Concrete Institute (UK) Oxford Black; well Scientific Publications, 2003.*	*3. Johnson.R.P, "Composite Structures of Steel and Concrete". Vol-I, # Oxford Black; well Scientific Publications (Third Edition) U.K. 2004.* *4. Subramanian.N, Design of Reinforced Concrete Structures, Oxford University Press New Delhi, 2013* *5. Subramanian.N, Design of Steel structures-Limit state method, Oxford University Press New Delhi, 2016*

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3(15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*30%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*50%*	-	*50%*	-	*50%*	-	*50%*	-	*60%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*20%*	-	*20%*	-	*20%*	-	*10%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Mini-Projects

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Er. G.Hariharanath, GA Consultants, Chennai, gac1996@hotmail.com	*1. Dr. R. Santhakumar, Professor, Centre for Rulal Department, NITTTR*	*Prof.G.Augustine Maniraj Pandian, SRMIST*
2. Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai, desigan.agv@gmail.com	*2. Dr. P. Jayabalan, NIT, Trichy, pjeya@nitt.edu*	*Prof. N.Umamaheswari, SRMIST*

Course Code	18CEE309T	Course Name	GEOGRAPHIC INFORMATION SYSTEM	Course Category	E	Professional Elective Course	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR): *The purpose of learning this course is to:*

		Learning		
		1	2	3
CLR-1 :	Introduce to mapping techniques			
CLR-2 :	Identification of the data and DBMS			
CLR-3 :	Interpretation and analysis of GIS Data			
CLR-4 :	perform various GIS analysis			
CLR-5 :	Understand the Digital elevation Model			
CLR-6 :	Apply the knowledge of GIS			

Course Learning Outcomes (CLO): *At the end of this course, learners will be able to:*

		Level of	Expected Prof.	Expected Attai	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	understand the GIS, background, Development of and Components of GIS	2	85	80	H	-	-	-	-	-	-	-	L	-	-	H	H	-	-
CLO-2 :	study the data capturing techniques in GIS & Database management	2	85	75	H	-	-	-	-	-	-	-	M	-	-	H	H	-	-
CLO-3 :	analyze various spatial and Non-spatial Data	2	80	75	H	-	M	M	H	-	H	-	M	-	-	H	H	-	-
CLO-4 :	Generation of various thematic	2	85	80	H	H	M	M	H	-	H	-	M	-	-	H	H	-	-
CLO-5 :	study the Generation and Application of DEM	2	85	75	H	H	H	M	H	H	H	-	M	-	-	H	H	-	-
CLO-6 :	appreciate the applications of GISI	2	80	75	H	H	H	H	H	H	H	-	M	-	-	H	H	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***Introduction & Définition***	***Data and Information***	***Data Analysis***	***Digital elevation model***	***Applications of GIS***
	SLO-2	*GIS in civil engineering*	*Data and data types*	*Spatial data analysis*	*DTM,DSM,*	*GIS in resource mapping*
S-2	SLO-1	*Historical background*	*Spatial data*	*Buffering-point, Line and polygon buffering*	*DEM -Data requirement*	*Land use and Land cover Analysis*
	SLO-2	*Concept of Development*	*Nonspatial data*	*Over lay –Point on polygon*	*Sources of DEM*	*Ground water Studies*
S-3	SLO-1	*Qualifications of GIS*	*Spatial data-raster data*	*Over lay –Line on polygon*	*Generation of DTM*	*Groundwater potential mapping and Artificial recharge suitability mapping*
	SLO-2	*Requirement of GIS*	*Spatial data-vector data*	*Over lay –Polygon on polygon*	*Generation of TIN*	*Runoff modeling*
S-4	SLO-1	*Elements of GIS*	*Merits and demerits of Raster data*	*Raster Over lay analysis*	*Generation of DEM*	*Forest mapping, Agricultural Studies-Crop yield estimation, acreage production etc*
	SLO-2	*Cartography*	*Merits and demerits of Vector data*	*Vector Over lay analysis*	*Parameters of DEM analysis*	*Disaster management studies-natural and artificial disasters*
S-5	SLO-1	*Digital cartography*	*Data input methods*	*Network analysis-Alternate route analysis*	*Applications of DEM*	*Flood and earthquake studies,*
	SLO-2	*Symbolization & Generalization*	*Data input methods- Digitization*	*Shortest path and proximity analysis*	*Slope and aspect*	*Drought management*
S6	SLO-1	*Map and definition of Map*	*Data input methods -Scanning*	*Reclassification*	*Use of EDM for Hydrological studies*	*Other disaster related studies*
	SLO-2	*Types of Map*	*Data input methods-Keyboard entry*	*Non-Spatial data Analysis - Query -object based and field based analysis*	*Groundwater studies*	*Wetland management,*

S-7	**SLO-1**	*Classification of Map Based on Scale*	*Data Output methods*	*Data Manipulation, Data Generalization*	*Site suitability for construction of Dam and Reservoir*	*Urban and Regional planning*
	SLO-2	*Classification of Map Based on purpose and Theme*	*Data Output methods-Soft copy output*	*Data Abundance and Data Redundancy*	*Consideration for Construction of Irrigation structure*	*Smart city mapping*
S-8	**SLO-1**	*Map Analysis*	*Data Output methods-Hard copy output*	*Data Retrieval-RDBMS*	*DEMs in site suitability for solar and wind energy generation*	*Smart Transportation systems*
	SLO-2	*Coordinate systems*	*Software modules ArcGIS, -Arcinfo, Arc Toolbox*	*Record modeling In GIS*	*DEMs in disaster studies-Flood Hazard Mapping,*	*Solid Waste management using GIS*
S-9	**SLO-1**	*Projection systems*	*ArcEdit, ArcMap, Arc catalog*	*Expert System-Artificial Intelligence*	*Landslide studies, Avalanches studies*	*Water qualitystudies*
	SLO-2	*Coordinate systems used in India*	*QGIS, and other open source softwares*	*Artificial Neural Networking*	*limitations of DEM*	*Soilmoisturestudies*

Learning Resources	1. Anji Reddy .M, "Remote sensing and Geographical information system",B.S Publications, 2011. 2. Chestern, "Geo Informational Systems - Application of GIS and Related Spatial Information Technologies », ASTER Publication Co., 1992. 3. Jeffrey Star and John Estes, "Geographical Information System - An Introduction", Prentice Hall, 1990.	4. Burrough .P.A, "Principles of GIS for Land Resources Assessment", Oxford Publication,1980 5. SatheeshGopi, "Global Positioning System - Principles and Applications," Tata McGrawHill Publishing Company Limited, New Delhi (India), 2005 *6. NPTEL: Course – GIS in Civil Engineering :* https://nptel.ac.in/courses/105102015/8

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*50%*	-	*40%*	-	*40%*	-	*45%*	-	*70%*	-
	Understand										
Level 2	Apply	*50%*	-	*60%*	-	*60%*	-	*55%*	-	*30%*	-
	Analyze										
Level 3	Evaluate	-	-	-	-	-	-	-	-	-	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Sarunjith K J, Scientist, NCSCM	*Dr. S.G.D. Sridhar, University of Madras*	*Dr. Sachikanta Nanda, SRMIST*
Dr. Nagasundaram M, Geological Survey of India, nagasundaram.m@gsi.gov.in	*Dr. Nisha Radha Krishnan, NIT TRichy*	*Dr. R Annadurai, SRMIST*

Course Code	18CEE305J	Course Name	CONCRETE TECHNOLOGY	Course Category	E	*Professional Elective Course*	L	T	P	C
							2	0	2	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	Nil	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes/Standards**	*IS 10262: 2019 and IS 456: 2000*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**		
		1	2	3
CLR-1 :	*Understand and test the properties of materials constitutes concrete*			
CLR-2 :	*Understand about chemical and mineral admixtures used in concrete. Also understand and test fresh concrete properties*			
CLR-3 :	*Know and understand the properties of concrete in hardened state*			
CLR-4 :	*Know and understand the durability properties of concrete and special concrete*			
CLR-5 :	*Understand the importance of concrete mix design*			
CLR-6 :	*Understand the process involved in manufacture of concrete*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level o	Expected Pro	Expected Attain	**Program Learning Outcomes (PLO)**														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering K	Problem A	Design & Dev	Analysis	Modern Tool	Society & Cul	Environment	Ethics	Indivi	Communica	Project Mgt.	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*Test and study the properties of cement, aggregates and water*	*3*	*80*	*75*	*H*	*M*	-	-	-	-	-	-	-	-	-	-	*L*	*H*	*M*
CLO-2 :	*Know the effects of admixtures in concrete and test the fresh concrete properties*	*3*	*85*	*75*	*H*	*M*	-	-	-	-	-	-	-	-	-	-	*L*	*H*	*M*
CLO-3 :	*Test the hardened concrete properties*	*3*	*75*	*75*	*H*	*M*	-	-	-	-	-	-	-	-	-	-	*L*	*H*	*M*
CLO-4 :	*Understand the importance of durability of concrete and properties of special concrete*	*3*	*90*	*80*	*H*	*L*	-	-	-	-	-	-	-	-	-	-	*L*	*H*	*M*
CLO-5 :	*Design the concrete mix without and with admixtures*	*3*	*85*	*75*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	*M*	*H*	*M*
CLO-6 :	*Know the various stages of manufacture of concrete*	*3*	*80*	*75*	*H*	*L*	-	-	-	-	-	-	-	-	-	-	*L*	*H*	*M*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***CONCRETE CONSTITUENTS MATERIALS*** *Overview. Cement, brought up, invention, chemical composition, oxide composition, limits and role.*	***ADMIXTURES*** Overview –Chemical and mineral admixtures – additive – plasticizers – definition – situation need high workability – effects of plasticizer in concrete.	***HARDENED CONCRETE*** Test – purpose – density - compressive strength test.	***DURABILITY OF CONCRETE*** Definition - significance – permeability – reasons for permeability in actual structures.	***CONCRETE MIX DESIGN*** Definition – Principle of mix design – Factors choice of mix proportion – Properties of concrete related to mix design.
	SLO-2	*Hydration - Bogue's compound – types of cement.*	Super plasticizers – effects in – fresh and hardened concrete.	Factors affects strength of concrete. Failure of compression specimen.	Joints in concrete – classifications.	Physical properties of materials required for mix design.
S-2	SLO-1	*Properties of cement - Tests on cement – field.*	*Accelerators – accelerating plasticizer.*	Flexural strength – central point load.	Concrete subjected to high temperature.	Nominal and design mix – variables in mix design.
	SLO-2	*Laboratory tests – fineness – specific gravity – procedures.*	*Retarders – use – materials. Water proofers.*	Flexural strength –third point load.	Freezing and thawing.	Objective of mix design – List of methods of mix design. Basic steps –– Information required for mix design.
S-3	SLO-1	*Determination of fineness of cement and normal consistency of cement practically in lab.*	*Determination of soundness of cement (Demo only) practically in lab.*	*Determination of crushing strength of coarse aggregate practically in lab.*	*Determination of flakiness and elongation index of coarse aggregate practically in lab.*	*Determination of flexural strength of concrete practically in lab.*
	SLO-2					
S-4	SLO-1	*Consistency - setting time of cement – initial and final setting time.*	*Fly ash – characteristics – use – classification –effects in fresh and hardened concrete.*	Indirect tension test.	Sulphate attack – methods to control.	Indian standard method of mix design - Step by step mix design procedure.
	SLO-2	*Soundness and strength of cement.*	*Silica fume – characteristics – effects in fresh and hardened concrete.*	Stress – strain curve.	Acid attack – concrete in sea water.	Mix design example : Without admixture
S-5	SLO-1	*Aggregates – classification – source - size – shape – texture.*	*GGBS - effects in fresh and hardened concrete – uses.*	Modulus of elasticity –determination.	Carbonation - factors.	Mix design examples: With chemical admixture and mineral admixture

	SLO-2	*Properties of aggregates and tests: Crushing – 10% fines – impact.*	*Metakaolin – application – advantages – uses.*	Different elastic moduli.	Chloride attack – limits of chloride.	
S-6	SLO-1	*Determination of initial setting time of cement and final setting time (Demo only) - practically in lab.*	*Determination of fineness modulus of coarse aggregate practically in lab.*	*Determination of impact resistance of coarse aggregate practically in lab.*	*Compressive strength of bricks and concrete cubes practically in lab.*	*Determination of split tensile strength of concrete practically in lab.*
	SLO-2					
S-7	SLO-1	*Abrasion – bulk density – specific gravity Absorption and moisture content – bulking.*	***FRESH CONCRETE*** Workability –factors – tests.	Impact resistance test – Impact energy.	Effects of some materials on durability.	**MANUFACUTRE OF CONCRETE** Process – various stages of manufacture of concrete.
	SLO-2	*Soundness – flakiness index – elongation index.*	Slump and compaction factor tests.	Impact energy calculation	Surface treatments of concrete – materials used.	Batching – mixing
S-8	SLO-1	*Grading – sieve analysis – fineness modulus.*	*Segregation – types – conditions – remedies.*	Shrinkage – classifications – factors affect.	Concrete permeability test - Rapid chloride penetration test.	Transporting – Methods adopted for transportation of concrete.
	SLO-2	*Water – quality – quantity.*	*Bleeding – effects – test.*	Creep – definition – measurement of creep – factors affect.	Introduction to special concretes.	Placing – compacting - curing – finishing.
S-9	SLO-1	*Determination of specific gravity of cement, fine and coarse aggregate practically in lab*	*Determination of bulking of sand practically in lab.*	*Determination of abrasion resistance of coarse aggregate practically in lab.*	*Workability of concrete – slump – compaction factor test practically in lab.*	*Determination of impact strength of concrete practically in lab.*
	SLO-2					

Learning Resources	1. Neville, A.M. Properties of Concrete, Fifth Edition, Pearson, 2011. 2. Shetty, M.S. Concrete Technology, Theory and Practice, S. Chand & Company, New Delhi, 2013. 3. A.R. Santhakumar, Concrete Technology, 2009 Edition, Oxford University Press	4. Kumar Mehta Paulo,P and Monteiro, J.M. Concrete Microstructure, Properties and Materials, Fourth Edition, McGraw Hill Education, 2006, copy right ©2014. 5. *NPTEL Course: Concrete Technology: https://nptel.ac.in/courses/105102012/* 6. *Laboratory Manual - SRMIST*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20 %*	*20 %*	*15 %*	*15 %*	*15 %*	*15 %*	*15 %*	*15 %*	*15 %*	*15 %*
	Understand										
Level 2	Apply	*20 %*	*20 %*	*20 %*	*20 %*	*20 %*	*20 %*	*20 %*	*20 %*	*20 %*	*20 %*
	Analyze										
Level 3	Evaluate	*10 %*	*10 %*	*15 %*	*15 %*	*15 %*	*15 %*	*15 %*	*15 %*	*15 %*	*15 %*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Er. G.Hariharanath, GA Consultants, Chennai, gac1996@hotmail.com	*1. Dr. R. Santhakumar, Professor, Centre for Rulal Department, NITTTR*	*1. Dr. K. Gunasekaran, SRMIST*
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Course Code	18CEE306T	Course Name	PRESTRESSED CONCRETE STRUCTURES	Course Category	E	*Professional Elective Course*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	Nil	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	**Data Book / Codes/Standards**	*IS 1343: 2012*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**		
		1	2	3
CLR-1 :	*Know and utilize the concepts of prestress concrete to analyseprestress concrete sections*			
CLR-2 :	*Know and understand the different losses of prestress and anchorage zone stress to design*			
CLR-3 :	*Understand flexural failure types and to analyze and also to design flexural and tension members*			
CLR-4 :	*Understand shear strength analyze and also to design for shear. Also to analyze due to torsion*			
CLR-5 :	*Know the design concept of prestressed concrete one way and two way slab*			
CLR-6 :	*Know the design concept of prestressed concrete flat slab*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level o	Expected Prof	Expected Attain	**Program Learning Outcomes (PLO)**														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Kn	Problem Anal	Design & Dev	Analysi	Modern Tool	Society & Cult	Environment	Ethics	Indivi	Communica	Project Mgt	Life Long L	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*Analyze the prestress concrete sections using different concepts*	*3*	*80*	*75*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	*H*	-	*M*
CLO-2 :	*Analyze the different losses of prestress and anchorage zone stress to design*	*3*	*85*	*75*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	*H*	-	*M*
CLO-3 :	*Analyze and design of prestressed concrete flexural and tension members*	*3*	*75*	*75*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	*H*	-	*M*
CLO-4 :	*Analyze and design of prestressed concrete for shear and also analyze due to torsion*	*3*	*90*	*80*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	*H*	-	*M*
CLO-5 :	*Design the prestressed concrete one way and two way slab*	*3*	*85*	*75*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	*H*	-	*M*
CLO-6 :	*Design the prestressed concrete flat slab*	*3*	*80*	*75*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	*H*	-	*M*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	***PRESTRESSED CONCRETE*** *Introduction - Basic concept – Principle of prestressing – Materials.*	***LOSSES OF PRESTRESS*** Nature of losses of prestress – types of losses of prestress in – pre and post tensioning.	***FLEXURAL STRENGTH ANALYSIS*** Flexural failure - control parameters.	***SHEAR STRENGTH ANALYSIS*** Shear and principal stresses – maximum and minimum principal stresses.	**PRESTRESSED CONCRETE SLAB** **Slabs types –cross section of floor panels.**
	SLO-2	*Forms of steel – systems of prestressing*		Types of flexural failure.	Eliminate diagonal tension cracks - improvement of shear resistance.	
S-2	SLO-1	*Types of prestressing – uses of prestressed concrete.*	Loss due to elastic deformation	Indian code provisions – moment of resistance – bonded tendons only.	Example without and with axial prestress	Design of one-way slab
	SLO-2	*Materials – concrete strength limitation – requirements of steel for prestressed concrete.*	*Example*	Rectangular section		
S-3	SLO-1	*Analysis – basic assumptions.*	*Loss due to shrinkage and creep of concrete*	*Examples*	Example with curved cable and vertical cable.	Example
	SLO-2	*Concentric and eccentric tendons – resultant stresses – at transfer – at service. Concepts of prestressing – rectangle – symmetrical I-section only.*	*Example*			
S-4	SLO-1	*Stress concept*	*Loss due to relaxation of steel – friction – anchorage slip.*	T – Sections. Neutral axis – within the flange – outside the flange.	**DESIGN FOR SHEAR** Types of shear cracks – sections uncracked in flexure – sections cracked in flexure.	Example
	SLO-2		*Example*	Examples	Design of shear reinforcement	
S-5	SLO-1	*Stress concept – examples*	**ANCHORAGE ZONE STRESSES** Anchorage zone – nature of stresses – objective.	**DESIGN FOR FLEXURE** Stress conditions - minimum section modulus – critical combinations – four fundamental conditions – at transfer – at service loads.	Examples	Design of two-way slab

	SLO-2		Stress distribution in end block – single and double anchor plates – ideal stress distribution.	Minimum prestressing force – maximum eccentricity.		
S-6	SLO-1	*Stress concept - examples*	*Effect of transverse tensile stress*	Examples	Examples	*Example*
	SLO-2		*Analysis of anchorage zone stress – methods (names only)*			
S-7	SLO-1	*Strength concept - examples*	*Indian standard method of analysis of anchorage zone stresses*	Examples	**TORSION ANALYSIS** Shear stress due to torsion - circular – rectangle – T –section and box section.	Design of simple flat slab
	SLO-2					
S-8	SLO-1	*Load balancing concept – cable profile – reaction – equivalent loads.*	*Examples*	**DESIGN OF TENSION MEMBER** Determination of area of concrete	Examples	*Example*
	SLO-2			Load factor – cracking and collapse		
S-9	SLO-1	*Load balancing concept – examples.*	*Design of anchorage zone.*	Example	Examples	*Example*
	SLO-2		*Example*			

Learning Resources	*7.* Krishnaraju .R, "Prestressed Concrete", Tata McGraw-Hill Education, Edition: 2018, NewDelhi. *8.* Pandit .G.S, Gupta .S.P, "Prestressed Concrete", CBS Publishers & Distributors, 2008 *9.* *S. Ramamrutham, "Prestressed Concrete", DhanpatRai Publishing Company, Fifth Edition, Reprint 2016* *10.* Lin T.Y, Design of, "Prestressed Concrete Structures", Asia Publishing House, Bombay 1995.	*11.* IS: 1343-2012 "IS Code of Practice for Prestressed Concrete", BIS, New Delhi, 2012. *12.* NPTEL Course: Prestressed Concrete Structures: https://nptel.ac.in/courses/105106117/

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

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