ACADEMIC CURRICULA

UNDERGRADUATE/ INTEGRATED POST GRADUATE DEGREE PROGRAMMES

(With exit option of Diploma)

(Choice Based Flexible Credit System)

Regulations 2021

Volume – 13
(Syllabi for Civil Engineering Programme Courses)
(Revised on August 2024)

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

ACADEMIC CURRICULA

Basic Science Course

Regulations 2021

SRM INSTITUTE OF SCIENCE & TECHNOLOGY
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SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

Course Code	21CEB201J	Course Name	APPLIED GEOLOGY	Course Category	B	BASIC SCIENCE	L	T	P	C
							3	0	2	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:***
CLR-1:	*understand the various geological processes*
CLR-2:	*explore the minerals of the earth crust*
CLR-3:	*know about the rocks of the earth crust*
CLR-4:	*understand the various geological structures*
CLR-5:	*learn the geological investigation techniques & geological considerations for civil engineering projects*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	**Program Outcomes (PO)**												**Program Specific Outcomes**		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*identify the geological agencies and their actions*	*2*	-	-	-	-	-	*2*	-	-	-	-	-	-	-	-
CO-2:	*analyze the physical property of rock forming minerals*	*2*	-	-	-	-	-	*2*	-	-	-	-	-	-	-	-
CO-3:	*classify, structure, identify texture and the distribution of various types rocks*	*3*	-	-	-	-	-	*3*	-	-	-	-	-	-	-	-
CO-4:	*interpret the various geological structure*	*3*	-	-	-	-	-	*3*	-	-	-	-	-	-	-	-
CO-5:	*apply the investigation techniques for civil engineering projects*	*3*	-	-	-	-	-	*3*	-	-	-	-	-	-	-	-

Unit-1 - Physical Geology	***12 Hour***
Scope of geology in civil engineering, interior of the earth, weathering of rock, geological actions of wind, river, sea, landslide, Earthquake, plate tectonics, Groundwater, Practices in topographic map, geomorphology features, contouring, and drainage pattern studies.	
Unit-2 - Mineralogy	***12 Hour***
Definition of a mineral, Rock forming minerals, Silicate group minerals: feldspar, quartz, mica –Non silicate group: calcite, iron-ore mineral ,clay mineral,- their physical properties, types, uses- coal , petroleum and their origin,- practices in identification of minerals , study the coal resource , petroleum resource map in India, ore minerals in India	
Unit-3 - Petrology	***12 Hour***
Definition of Rock, Rock cycle, Types of rock: Igneous, Sedimentary and Metamorphic rocks - origin, types, mineral composition, textures and structures, practices in rocks: Identification of rocks, Study of engineering properties of rock, occurrence and distribution of rocks in India	
Unit-4 - Geological Structures	***12 Hour***
Deformation of rocks, causes, types- Fold, fault, joint- origin, types and their importance, Practices:- attitude of rock bed- Dip and Strike, Clinometer, geological mapping, profiling, satellite imageries ,Photointerpretation , Stereoscopes, identification of structures from satellites imagery	
Unit-5 - Geology in Civil Engineering	***12 Hour***

Method of investigation- Geological, Geophysical- Remote sensing Data, Geology Parameters for Dam and Reservoirs, Tunnel, Road, Building, Bridge Site, Practices: -soil profiling, study of landslide zone, earthquake risk zone mapping in India, Electrical Resisvity survey, Study the Geological Structures associated with dam, reservoir and tunnel structures.

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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (45%)		*Life-Long Learning CLA-2 (15%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	-	*15%*	*20%*	-
Level 2	*Understand*	*20%*	-	-	*15%*	*20%*	-
Level 3	*Apply*	*20%*	-	-	*20%*	*20%*	-
Level 4	*Analyze*	*20%*	-	-	*20%*	*20%*	-
Level 5	*Evaluate*	*10%*	-	-	*15%*	*10%*	-
Level 6	*Create*	*10%*	-	-	*15%*	*10%*	-
	Total	*100 %*		*100 %*		*100 %*	

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*	1. *Dr. R. Nagendra, Anna University, geonag@gmail.com*	1. *Dr. R Annadurai, SRMIST*
2. *Dr. Nagasundaram M, Geological Survey of India, nagasundaram.m@gsi.gov.in*	2. *Dr. S. G. D. Sridhar, University of Madras, sgd.sri@unom.ac.in*	2. *Dr. Sachikanta Nanda, SRMIST*

ACADEMIC CURRICULA

Engineering Science Courses

Regulations 2021

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

Course Code	21CES201T	Course Name	MECHANICS OF STRUCTURES	Course Category	S	ENGINEERING SCIENCE	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:	*explore the concepts of vectors, stresses in compound sections*
CLR-2:	*awareness on the properties of plane areas*
CLR-3:	*learn the bending moment and shear force for determinate beams and compute the stresses along beam cross section*
CLR-4:	*get insight into the concepts of the internal forces in pin jointed plane trusses*
CLR-5:	*get insight into indeterminate beams*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*analyze the state of stress and stresses in compound sections*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*identify the properties of plane areas in plates and simple solids*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*determine the bending moment, shear force and stress distribution along the beam*	*3*	*3*	-	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*analyse and determine the internal forces in pin jointed plane trusses by various methods*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*apply Macaulay's method, Clapeyron's theorem to solve indeterminate beam problems*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Basics of Mechanics, Stress, Strain and Deformation of Solids ***9 Hour***

Vectors-Concept of forces-Concept of particle and rigid body -Non-concurrent and parallel forces in a plane - Moment of force and Varignon's theorem –Free body diagram-conditions of equilibrium-Principle of virtual work-equivalent force system. Rigid bodies and deformable solids - tension, compression and shear stresses - strain - Lateral strain - Poisson's ratio - Volumetric strain – Deformation of simple and compound bars - Elastic constants - Composite sections – Thermal stresses.

Unit-2 - Moment of Inertia and Principal Stresses and Planes ***9 Hour***

Areas and volumes - Theorems of Pappus and Guldinus - Centroid of simple areas and volumes by integration - centroid of composite areas - Second and product moment of areas - radius of gyration - parallel axis and perpendicular axis theorems - moment of inertia of simple areas by integration -moment of inertia of composite areas - mass moment of inertia of thin plates and simple solids. Two Dimensional - Stresses on inclined planes - Combined stresses – Principal stresses and Principal planes - Mohr's circle of stress - State Of Stress In Three Dimensions: Spherical and deviatric components of stress tensor - determination of Principal stresses and Principal planes – Theories of Failure – Shear center

Unit-3 - Bending and Stresses of Beams ***9 Hour***

Beams - types of Support - Types of load - S.F and B.M in beams - Cantilevers, Simply supported and Overhanging beams with different types of loading - Relationship between B.M and S.F - Theory of simple bending - Bending stress and Shear stress distribution for various Cross sections - Analysis of stresses - load carrying capacity - Proportioning of sections - Shear flow- beams of uniform strength- Theory of pure torsion

Unit-4 - Analysis of Statically Determinate Plane Trusses ***9 Hour***

Stability and Equilibrium of plane frames - Perfect frames - Types of Trusses - Analysis of forces in truss members - Method of joints - Method of Sections - Tension Co-efficient method - Graphical method.

Unit-5 - Indeterminate Beams	***9 Hour***
Introduction to static & kinematic indeterminacy - Static and kinematic indeterminacy of two and three dimensional pin and Rigid jointed structures - Analysis of indeterminate beams, propped cantilever beams, fixed beam by Macaulay's method. Clapeyron's theorem of three moments - Continuous beam, Continuous beams with different settlement and different end conditions.	

Learning Resources		
	8. *Punmia.B.C, Ashok Kumar Jain, Arun Kumar Jain, "Mechanics of Materials", Laxmi Publications (P) Ltd., 2003.* 9. *Timoshenko.S.P and Gere.J.M, "Mechanics of Materials", A&C, Black 2 Ed. 1990.*	10. *Rajput .R. K, "Strength of Materials: Mechanics of Solids", Edition 4, S. Chand Limited, New Delhi, 2007.* 11. *Ramamrutham .S, Narayan .R, "Strength Of Material"s, Dhanpat Rai Publishing Company (P) Limited, 2008*

Learning Assessment								
	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Er. K. Jayasankar, Senior Vice President, Ultra Tech Cement Limited, Mumbai*	1. *Dr. R. Senthil, Professor, Anna University, Chennai*	1. *Dr. P.R.Kannan Rajkumar, SRMIST*
2. *Dr. P. Manoharan, Regional Executive Engineer, Madurai, Municipal Administration.*	2. *Dr. R. Baskar, Professor, Annamalai University, Chidambaram*	2. *Dr. N. Parthasarathi, SRMIST*

ACADEMIC CURRICULA

Professional Core Courses

Regulations 2021

SRM INSTITUTE OF SCIENCE & TECHNOLOGY
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Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

Course Code	21CEC201L	Course Name	FLUID MECHANICS AND MACHINERY 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:***
CLR-1:	*understand calibration of various flow measurement devices*
CLR-2:	*know major and minor losses in pipes*
CLR-3:	*explore the applications of Bernoulli's principle*
CLR-4:	*comprehend the applications of various pumps*
CLR-5:	*realize the applications of various turbines*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*explain calibration of various flow measurement devices*	*3*	*3*	-	-	-	-	-	-	*3*	-	-	-	*3*	-	*3*
CO-2:	*solve major and minor losses in pipes*	*3*	*3*	-	-	-	-	-	-	*3*	-	-	-	*3*	-	*3*
CO-3:	*illustrate the applications of Bernoulli's principle*	*3*	*3*	-	-	-	-	-	-	*3*	-	-	-	*3*	-	*3*
CO-4:	*discriminate the working of various pumps*	*3*	*3*	-	-	-	-	-	-	*3*	-	-	-	*3*	-	*3*
CO-5:	*distinguish the working of various turbines*	*3*	*3*	-	-	-	-	-	-	*3*	-	-	-	*3*	-	*3*

Practice-	***30 Hour***
Practice 1: Determine coefficient of discharge of Orifice / outhpiece	
Practice 2: Determine coefficient of discharge of a Venturimeter / Orificemeter	
Practice 3: Calibration of Rotometer / Pitot tube	
Practice 4: Determination of Major loss in a pipe	
Practice 5: Determination of Minor losses in a pipe	
Practice 6: Determine coefficient of discharge of a Rectangular notch / Triangular notch	
Practice 7: Verification of Bernoulli's theorem	
Practice 8: Determination of hydraulic jump	
Practice 9: Determination of metacentric height	
Practice 10: Test performance of Centrifugal pump	
Practice 11: Test performance of Reciprocating pump	
Practice 12: Test performance of Submersible pump	
Practice 13: Test performance of Gear oil pump	
Practice 14: Test performance of Pelton turbine	
Practice 15: Test performance of Kaplan / Francis turbine	

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 (CLA)*						*Final Examination (0% weightage)*	
		CLA-1 Average of first cycle experiments (30%)		*CLA-2 Average of second cycle experiments (30%)*		*Practical Examination (40%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 2	*Understand*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 3	*Apply*	-	*30%*	-	*30%*	-	*30%*	-	-
Level 4	*Analyze*	-	*30%*	-	*30%*	-	*30%*	-	-
Level 5	*Evaluate*	-	-	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100%*		-	

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. G.Premkumar, SRMIST*

Course Code	21CEC201T	Course Name	HYDROMECHANICS AND HYDRAULIC ENGINEERING	Course Category	C	PROFESSIONAL CORE	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:	*study the various properties of fluids and explore hydrostatics*
CLR-2:	*understand hydrokinematics*
CLR-3:	*explore hydrodynamics*
CLR-4:	*address concepts on flow through pipes*
CLR-5:	*introduce the components, functions and uses of pumps and turbines*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*appraise the various properties of fluids and the concepts of hydrostatics*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*solve problems on hydrokinematics*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*solve problems on hydrodynamics*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*analyze laminar and turbulent flow in pipes*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*distinguish the components, functions and uses of pumps and turbines*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Fluid Properties and Hydrostatics	***9 Hour***
Properties of fluids - Mass density, Specific weight, Specific gravity, Viscosity, Surface tension, Capillarity, Bulk modulus, Compressibility - Hydrostatics – Pressure – Static, absolute and gauge pressure – Forces on planes – Center of pressure – Buoyancy and floatation.	
Unit-2 - Hydrokinematics	***9 Hour***
Classification and types of fluid flow – Velocity & Acceleration of a fluid particle - Stream line, Path and Streak line – Stream function - Potential function – Flow net – Equipotential line - Control volume – Forced and free vortex flow.	
Unit-3 - : Hydrodynamics	***9 Hour***
Continuity equation –Euler's equation - Bernoulli's equation – Applications – Venturimeter, Orificemeter and Pitot tube – Orifice and Mouthpiece – Notches / Weirs - Rectangular and Triangular types – End contraction – Velocity of approach	
Unit-4 - : Flow Through Pipes	***9 Hour***
Reynold's experiment - Laminar and turbulent flow - Reynold's number – Darcy-Weisbach's equation – Moody's diagram - Major and minor losses – Pipes in series and parallel – Equivalent pipes – Water hammer – Syphon pipe	
Unit-5 - Pumps and Turbines	***9 Hour***
Pumps - Classifications – Centrifugal and Reciprocating pumps – Components & Working principle – Specific speed – Characteristics curves. Turbines - Classifications – Pelton turbine, Kaplan turbine and Francis turbine – Components - Work done – Specific speed – Characteristics curves	

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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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. *Mr. G. Premkumar SRMIST*

Course Code	21CEC202L	Course Name	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:*
CLR-1:	*utilize the principles and application of plane table surveying*
CLR-2:	*utilize the principals of levelling*
CLR-3:	*utilize the principles and operation of theodolite*
CLR-4:	*know the various advance surveying equipment's*
CLR-5:	*implement the knowledge gained to solve the real time problems*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*traverse and prepare the site layout*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-2:	*profile land levels and contouring*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-3:	*determine horizontal distance of the inaccessible targets*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-4:	*disseminate the knowledge on advance equipment's and technology*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-5:	*recognize the knowledge gained in various field of surveying*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	*3*	*3*	*3*

Exercise Cycle I	***30 Hour***
Practice 1: Plane Table Surveying by Radiation Method	
Practice 2: Plane Table Surveying by Intersection Method	
Practice 3: Plane Table Surveying by Two Point Problems	
Practice 4: Plane Table Surveying by Three Point Problems (Trial and Error Method)	
Practice 5: Fly and Check leveling using dumpy/tilting level by both method /(Height of Collimation method and Rise and Fall)	
Practice 6: Reduction of leveling using dumpy level by both method / (Height of Collimation method and Rise and Fall)	
Exercise Cycle II	
Practice 1: Theodolite, Measure horizontal angles by repetition and reiteration method	
Practice 2: Height and distance by Single Plane Method	
Practice 3: Height and distance by Double Plane Method	
Practice 4: Determine the, gradient of a line joining two points by adopting Stadia hair method.	
Practice 5: Determine the gradient of a line by tangential method of Tacheometry	
Practice 6: Determine the horizontal distance between the instrument station and the subtense bar station.	

Exercise Cycle III
Practice 1: Collect the coordinates using handheld GPS
Practice 2: Determination of Area using Total Station
Practice 3: Determination of Remote height measurement of the altitude of given elevated points using Total Station.
Practice 4: Determination of Area of objects for the given location from a stereopair using the parallax bar.
Practice 5: Determination of various features from the Aerial photographs using Photointerpretation Key Techniques
Practice 6: Determination of various features from the Satellite Image using Image Interpretation Keys Techniques
Survey Camp List of Experiments (One week Survey Camp will be conducted during winter/summer vacation in the following activities)
Practice 1: Triangulation and Trilateration using Total Station
Practice 2: Set out a simple curve by Rankine's method of tangential angle using Total Station.
Practice 3: Determine the contours (GRID/RADIAL) for a given location using Dumpy level (or) Total Station
Practice 4: Determine the levels of a roadway along Longitudinal Section and Cross Section using Dumpy level (or) Autolevel
Practice 5: GPS operation system and surveying measurements
Practice 6: Observed and record the topographical feature points in given location using total station

Learning Resources	1. *Kanetkar. T.P, "Surveying and Levelling" Vols. I and II, United Book Corporation, Pune, 1994.* 2. *Surveying and leveling Part I"I, Late T P Kanetkar and Prof. S V Kulkarni, Poona Vidyagriha Prakashan*	3. *Punmia. B.C, "Surveying, Vols". I and II, Laxmi Publications,1999*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*						*Final Examination (0% weightage)*	
		CLA-1 Average of first cycle experiments (30%)		*CLA-2 Average of second cycle experiments (30%)*		*Practical Examination (40%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 2	*Understand*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 3	*Apply*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 4	*Analyze*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 5	*Evaluate*	-	*10%*	-	*10%*	-	*10%*	-	-
Level 6	*Create*	-	*10%*	-	*10%*	-	*10%*	-	-
	Total	*100 %*		*100 %*		*100 %*		-	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *.Mr G Hariharanath, Chief Executive ,GA consultants*	1. *Dr. E S M. Suresh, NITTR*	1. *Dr. S. Durgadevagi, SRMIST*
2. *.Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai*	2. *Dr. Srinivasa Raju, IRS, Anna University*	2. *Dr. A. Manimaran, SRMIST*

Course Code	21CEC202T	Course Name	ENGINEERING SURVEYING	Course Category	C	PROFESSIONAL CORE	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:	*utilize the concepts of levelling*
CLR-2:	*utilize the knowledge of surveying in carrying out Civil Engineering works*
CLR-3:	*study advances in surveying instruments*
CLR-4:	*explore Photogrammetry and its principles, Understand remote sensing*
CLR-5:	*understand Geographical Information System*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*apply the acquired knowledge on topographical mapping through levelling, measurement of horizontal and vertical distance*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*calculate areas, volumes and setting out curves*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*apply the knowledge on the Various techniques available for surveying and mapping with Electronic Distance Measuring Instrument, Total Station, and Global Positioning System*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*analyze the concept of aerial photo interpretation, Relate different aspects of remote sensing.in civil engineering*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*recognize the application of GIS in Civil Engineering*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Surveying Measurement of Horizontal and Vertical Distance	***9 Hour***
Overview of Surveying and Indian Topographic Map – Fundamentals of Mapping – Measurements and Errors – Significant Figures – Measurement of Vertical Distance – Instrument – Levels – Permanent Adjustment of Level – Levelling Principle, Methods and Differential Levelling – Profile Leveling – Reciprocal and Trigonometric Leveling – Errors, Mistakes and Precautions in Leveling – Representation of Vertical Distance – Measurement of Relative Direction of Line – Theodolite and its temporary adjustment – Permanent adjustment of Theodolite – Theodolite Measurement and Errors – Measurement of Horizontal and Vertical Distance Simultaneously – Basics of Tacheometry and Stadia System – Non–stadia Systems	
Unit-2 - Contour Gradient and Control Survey	***9 Hour***
Contours, contouring methods – Characteristics of contours – Uses of contours – Plotting – Calculation or Determination of Catchment/Drainage/ Railway embankments areas and volumes – Storage capacity of a Reservoir. Traverse Surveying – Traverse Computation – Coordinate Computation Omitted Measurement – Plotting of Traverse – Route Survey – Simple Circular Curve – Layout of a Simple Circular Curve – Transition and Combined Curve – Vertical Curve	
Unit-3 - Modern Surveying Equipment/ Techniques	***9 Hour***
Introduction – Electronic Distance Measuring Instrument (EDMI) – Principle, instrument characteristics, accessories, operation, EDM without reflecting Prisms – Electronic Theodolite and Total Station Measuring principle, Working principle, Sources of Error – field techniques, Traversing, motorized total stations; field procedures for total stations in topographic surveys – Modern Surveying Equipment – Introduction to Global Positioning System – Positioning Methods using Satellites – GPS Principles – GPS receivers – More on GPS principles – GPS Application – GPS Errors and Accuracy – Error sources in GPS observations – Satellite geometry and Accuracy measures – Other Satellite navigation Systems and GPS Modernization – References	

Unit-4 - Advance in Remote Sensing	***9 Hour***
Introduction – Physical basis of remote sensing (Electromagnetic Radiation (EMR), (Electromagnetic Spectrum) – EMR interaction in Atmosphere, Ground: Surfaces, Water & Snow, Soil) – Sensors and Platform Techniques – Remote sensing: Interpretation – Introduction to image processing techniques – Image enhancement – Information extraction.	
Unit-5 - Modern Techniques Tools Using Geographical Information System	***9 Hour***
Geographical Information System Introductory Concepts – GIS – Data Input – Data Verification, Editing, Manipulation, Analysis and Modelling – GIS Data Base – Spatial Analysis – Map Overlay and Spatial Correlation – Application to Drought Management – GIS base planning model for educational facilities in rural areas – Application extraction of building attributes – Zonal based planning using remote sensing – Application of remote sensing in Civil Engineering approach	

Learning Resources	1. *Kanetkar. T.P, "Surveying and Levelling" Vols. I and II, United Book Corporation, Pune, 1994.* 2. *Surveying and leveling Part I"I, Late T P Kanetkar and Prof. S V Kulkarni, Poona Vidyagriha Prakashan,* 3. *Punmia. B.C, "Surveying, Vols". I and II, Laxmi Publications, 1999.*	4. *https://swayam.gov.in/nd1_noc19_ce34* 5. *https://nptel.ac.in/noc/individual_course.php?id=noc18-ce35 (Part I and II)*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	*–*	*20%*	*–*	*20%*	*–*
Level 2	*Understand*	*20%*	*–*	*20%*	*–*	*20%*	*–*
Level 3	*Apply*	*20%*	*–*	*20%*	*–*	*20%*	*–*
Level 4	*Analyze*	*20%*	*–*	*20%*	*–*	*20%*	*–*
Level 5	*Evaluate*	*10%*	*–*	*10%*	*–*	*10%*	*–*
Level 6	*Create*	*10%*	*–*	*10%*	*–*	*10%*	*–*
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Er. Hariharanath, GA Consultants, Chennai*	1. *Dr. K. Srinivasa Raju, Anna University*	1. *Dr. S. Durgadevagi, SRMIST*
2. *Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai*	2. *Dr. E.S.M. Suresh, NITTTR, Chennai*	2. *Dr. A. Manimaran, SRMIST*

Course Code	21CEC203L	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:
CLR-1 :	identify the characteristics of water
CLR-2 :	understand the tests on water, wastewater and air
CLR-3 :	learning the instruments and methods used to conduct the tests on water, air and noise
CLR-4 :	study the principle and conduction of titration, and instrumental analysis
CLR-5 :	study the principle and importance of air pollution

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	analyze the characteristics of water and wastewater	3	2	-	-	-	-	3	-	-	-	-	-	3	-	3
CO-2:	able to compare the results with standard	3	2	-	-	-	-	3	-	-	-	-	-	3	-	3
CO-3:	identify the working of turbidity meter, pH meter electrical conductivity meter	3	2	-	-	-	-	3	-	-	-	-	-	3	-	3
CO-4:	interpret and analyze the results based on the standards	3	2	-	-	-	-	3	-	-	-	-	-	3	-	3
CO-5:	evaluate the quality of air and noise level	3	2	-	-	-	-	3	-	-	-	-	-	3	-	3

Practice -	30 Hour
Practice 1: Study of common instruments Required to conduct Experiments.	
Practice 2: Determine turbidity, electrical conductivity, pH	
Practice 3: Determine solids contents in water Total, volatile, fixed, suspended, dissolved, settle able and inorg	
Practice 4: Determine optimum coagulant dose	
Practice 5: Determine total hardness, calcium and magnesium hardness and Determine alkalinity and acidity	
Practice 6: Determine chloride and sulphate	
Practice 7: Determine copper	
Practice 8: Determine dissolved oxygen (DO) and biological oxygen demand (BOD)	
Practice 9: Determine chemical oxygen demand (COD)	
Practice 10: Monitor ambient air quality (TSP, RSPM), Monitor ambient air quality (Sox) Monitor ambient air quality (NOX)	

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. Laboratory manual for Environmental Engineering laboratory, SRMIST

Learning Assessment									
	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*						*Final Examination (0% weightage)*	
		CLA-1 Average of first cycle experiments (30%)		*CLA-2 Average of second cycle experiments (30%)*		*Practical Examination (40%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 2	*Understand*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 3	*Apply*	-	*30%*	-	*30%*	-	*30%*	-	-
Level 4	*Analyze*	-	*30%*	-	*30%*	-	*30%*	-	-
Level 5	*Evaluate*	-	-	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*		-	

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. S. Dhanasekar, 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	21CEC203T	Course Name	ENVIRONMENTAL ENGINEERING AND DESIGN	Course Category	C	PROFESSIONAL CORE	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:	*create insights to the various sources of water supply and its quality*
CLR-2:	*address concepts related to design of water treatment for domestic supplies*
CLR-3:	*address concepts related to design sewage treatment for towns and cities*
CLR-4:	*address concepts related to methods of sewage disposal*
CLR-5:	*address concepts related to solid waste management*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1 Engineering Knowledge	2 Problem Analysis	3 Design/development of solutions	4 Conduct investigations of complex problems	5 Modern Tool Usage	6 The engineer and society	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*understand the various sources of water and its quality*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-
CO-2:	*able to design the water treatment units for domestic purposes*	*3*	-	*3*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*knowledge of collection and conveyance of domestic sewage and design*	*3*	-	*3*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*knowledge of sewage disposal in land and water bodies*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-
CO-5:	*apply the concept of reducing, reuse, recycling in solid waste managements*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-

Unit-1 - Introduction to Water Supply — ***9 Hour***

Water quality requirement for different beneficial uses - Importance of water supply scheme and Need for protected water supply - Various sources of water available for supply - Per capita consumption-Demand - Quality issues in various sources of water - Water Pollution, sources, causes and effects. Water quality characteristics - WHO and BIS standards and Water Borne Diseases - Population forecast using different methods - Water requirements for industrial need and agriculture - Components of water supply system - Transmission of water and distribution system - Service reservoirs used in water supply – Tutorial Problems on forecast, per capita demand.

Unit-2 - Water Treatment — ***9 Hour***

Concept and objectives of water treatment - Principles of Aeration and Sedimentation. Types of sedimentation & design - Principles of Coagulation and Flocculation - Types of coagulants used in water treatment - Concept and theory of Filtration - Working principles of slow sand filters and design - Working principles of rapid sand filters and design - Disinfection of water and Chlorination - Advanced treatment - adsorption - ion exchange - membrane processes - UV methods - Effective water management Rain water harvesting methods - Measures taken for protecting the existing water bodies – Designing problems on Sedimentation, SSF and RSF

Unit-3 - Sanitary Engineering — ***9 Hour***

Domestic and storm water Quantity of sewage and flow variations - Conveyance of sewage and types of sewers. Design of sewers - Pumping of sewage and sewer appurtenances - Laying and jointing of sewer lines - Different plumbing systems adopted in buildings - Sanitary fittings used in buildings. Quantification of storm water - Concept of Primary, Secondary and Tertiary treatments - Screening and Grit Chambers - Concept of aerobic and anaerobic treatment systems - Primary settling tanks and Secondary settling tanks - Principles of septic tanks and design - Activated Sludge Process and Trickling Filters – Designing problems

Unit-4 - Disposal of Sewage — ***9 Hour***

Concept of sewage disposal - Pollution due to improper disposal of sewage - Zones of pollution and Self-purification of rivers - Oxygen sag curve. National river cleaning plans Dissolved Oxygen and BOD - Oxygen sag curve. National river cleaning plans Dissolved Oxygen and BOD - Sewage sickness and remedial measures - Concept of sludge management - Thickening, Conditioning and Dewatering of sludge - Various disposal methods of sludge - Energy recovered from sludge - Revenue from end product of sludge management - Design of Sludge digestion tanks

Unit-5 - Solid Waste Management and Air Pollution	***9 Hour***
Concept and generation of solid waste - Municipal Solid Waste(MSW), composition and other parameters - Quantification and Collection of MSW - Treatment and disposal of MSW - Waste from commercial establishments and other urban areas - Effect of solid waste on environment - Segregation and disposal methods of solid waste - Reduction at source, recovery and recycle - Basic concept of Air Pollution: properties and monitoring of Air pollutants - Air quality standards and control measures for Air Pollution - Basic concept of Noise Pollution and measurements - Various control methods of noise pollution - Acceptable standards for Noise levels	

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, New Delhi, 2017* 3. *S.K.Garg, Sewage Disposal and Air Pollution Engineering,, Khanna Publishers, NewDelhi, 2017* 4. *M.N. Rao, HVN Rao, Air Pollution, Tata McGraw Hill, New Delhi, 2007.*	5. *CPHEEO Manual on Water Supply and Treatment, Ministry of Drinking water and Sanitation, New Delhi, 2015* 6. *George Tchobanoglous, Hilary Theisen and Samuel Vigil, Integrated Solid Waste Management, McGraw Hill, Singapore, 1993.* 7. *CPHEEO Manual on Sewerage and Sewage Treatment, Ministry of Urban Development, New Delhi, 2010*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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. *Dr. K. Prasanna, SRMIST*
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	21CEC204T	Course Name	STRUCTURAL ENGINEERING DESIGN-I	Course Category	C	PROFESSIONAL CORE	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:	*know the behaviour of Masonry structure and retaining wall*
CLR-2:	*understand the design of RC using limit state method and know the behavior of slab using limit state method*
CLR-3:	*study the concept of performing design of beam and staircase using limit state method*
CLR-4:	*study the concepts of performing design of short and long column using limit state method*
CLR-5:	*study the concepts of performing design of foundation*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*design masonry structures like walls, columns, and foundation incorporating earthquake resistant features*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	*3*	-	-
CO-2:	*bring about an understanding of the behaviour of reinforced concrete, the design philosophies mix design*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	*3*	-	-
CO-3:	*design RCC beams and slabs, columns and footings including structural design of piles and pile caps*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	*3*	-	-
CO-4:	*design RCC columns and footings including structural design of piles and pile caps*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	*3*	-	-
CO-5:	*design RCC footings including structural design of piles and pile caps*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	*3*	-	-

Unit-1 - Masonry	***9 Hour***
Introduction to Strength of bricks and brick masonry Structural design of walls using BIS Codes and use of nomograms, Design of Masonry piers and columns, Design of footings for walls and columns Earthquake resistant features in masonry buildings as per BIS codes - Masonry retaining walls	
Unit-2 - Mix Design and Behaviour of RCC Sections	***9 Hour***
Introduction to various Grades of Concrete and the concrete mix design of nominal mix and design mix as per BIS codes, Theories of basic design concepts, working stress method, limit state method of design, behavior of RCC beams / slabs in flexure and shear, general codal recommendations for limit state method, Limit state method of design of one-way slabs Limit state method of design of two-way slabs, Limit state method of design continuous slabs and reinforcement detailing	
Unit-3 - Limit State Method of Design of Beams and Staircases	***9 Hour***
Concept of Transfer of load from slab to beam, Limit state method of design of singly reinforced beams, Limit state method of design of doubly reinforced, beams, Limit state method of design of Flanged beams, Design of Staircases and use of SP34 for reinforcement detailing	
Unit-4 - Limit State Method of Design for Columns	***9 Hour***
Limit state method of design of short and long columns, effective length of columns, braced and unbraced columns, Design of Axially loaded short columns, Uni-axial and biaxial bending of columns using interaction curve (SP16), shear in columns, Design of Long Columns, Ductile detaining of columns, reinforcement detailing at beam-column joints using SP34, extension of design of columns to piles	
Unit-5 - Limit State Method of Design for Foundations	***9 Hour***
Limit state method of design of isolated foundations, axially loaded Limit state method of design of isolated foundations eccentrically loaded Transfer of forces at column - foundation junction Limit state method of design of combined foundations Pile foundation, pile caps (2/4 piles) and reinforcement detailing	

Learning Resources	1. *Varghese.P.C, "Limit State Design Of Reinforced Concrete", 2nd Ed,PHI Learning Pvt. Ltd., 2004.* 2. *Unnikrishna Pillai.S and Deavadas Menon, "Reinforced Concrete Design," Tata MacGraw Hill Publishing Company Limited, Second Edition, New Delhi, 2003.* 3. *Krishnaraju .R, Pranesh .R.N, "Design of Reinforced concrete IS: 456-2000", New Age International Publication (P) Ltd., New Delhi, 2003.* 4. *Gambhir.M.L, "Design of Reinforced Concrete Structures", Prentice Hall of India, Pvt. Ltd., New Delhi, 2008.*	5. *Subramanian.N, "Design of Reinforced Concrete Structures", Oxford University Press, New Delhi, 2013.* 6. *Anand. S and Arya, "Masonry and Timber Structures Including Earthquake Resistant Design", Nem Chand and Brothers, Roorkee, 1987.* 7. *Dayaratnam.P, "Brick & Brick Reinforced Structures", Oxford & IBH Publications Company Pvt. Ltd.,*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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. *Dr. M. Prakash, SRMIST*

Course Code	21CEC204L	Course Name	CONCRETE TECHNOLOGY AND 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:***
CLR-1:	*explore the testing procedure to determine properties of materials constitutes concrete*
CLR-2:	*know and understand and test fresh and hardened concrete properties*
CLR-3:	*know the Compressive strength, split tensile strength and flexural strength of concrete*
CLR-4:	*explore the stiffness and deflection of helical springs*
CLR-5:	*get insight into the testing procedure of torsional, impact strength of steel and double shear test and hardness test Utilize non-destructive testing technique of rebound hammer and UPV tests*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*test and study the properties of cement, aggregates and concrete properties*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	-	-
CO-2:	*understand the importance of test fresh and hardened concrete properties*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	-	-
CO-3:	*disseminate the knowledge of Compressive strength, split tensile strength and flexural strength of concrete*	*2*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	-	-
CO-4:	*compute stiffness and deflection of helical springs*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	-	-
CO-5:	*identify torsional, impact strength of steel, non-destructive testing technique of rebound hammer and UPV tests*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	-	-

Practice -	***30 Hour***
Practice 1: Determination of specific gravity of cement, Determination of fineness, normal consistency, initial and final setting time of cement	
Practice 2: Determination of specific gravity of fine aggregate, Determination of bulking of sand of fine aggregate	
Practice 3: Determination of specific gravity of coarse aggregate, Determination of fineness modulus of coarse aggregate using sieve analysis	
Practice 4: Determination of Flakiness index and elongation index of coarse aggregate, Determination of abrasion resistance of coarse aggregate	
Practice 5: Determination of crushing and impact strength of coarse aggregates	
Practice 6: Determination of the degree of workability of fresh concrete using slump cone and compaction factor test	
Practice 7: Izod Impact test, Torsion test on mild steel Rod	
Practice 8: Rockwell Hardness and Brinell Hardness Test, Double shear test on Mild Steel Rod	
Practice 9: Deflection test (Central Loading and Non-central loading)	
Practice 10: Spring Test, Charpy Impact Test	
Practice 11: Tensile test on Steel Rod, Bond Resistance by Pull-Out Test	
Practice 12: Non-Destructive Test- Rebound Hammer, Non-Destructive Test-Ultrasonic Pulse Velocity	
Practice 13: Determination of compressive strength of concrete cube and split tensile strength of concrete cylinders, Determination of modulus of rupture of concrete standard beams	

Learning Resources	1. Shetty, M.S. Concrete Technology, Theory and Practice, S. Chand & Company, New Delhi, 2013 2. A.R. Santhakumar, Concrete Technology, 2009 Edition, Oxford University Press	3. NPTEL Course: Concrete Technology: https://nptel.ac.in/courses/105102012/ 4. Laboratory Manual for concrete technology and strength of materials laboratory - SRMIST

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)						Final Examination (0% weightage)	
		CLA-1 Average of first cycle experiments (30%)		CLA-2 Average of second cycle experiments (30%)		Practical Examination (40% weightage)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	20%	-	20%	-	20%	-	-
Level 2	Understand	-	20%	-	20%	-	20%	-	-
Level 3	Apply	-	30%	-	30%	-	30%	-	-
Level 4	Analyze	-	30%	-	30%	-	30%	-	-
Level 5	Evaluate	-	-	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-	-	-
	Total	100 %		100 %		100%		-	

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
2. Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai, desigan.agv@gmail.com	2. Dr. P. Jayabalan, NIT, Trichy, pjeya@nitt.edu	2. Dr. P. R. Kannan Rajkumar, SRMIST

Course Code	21CEC205T	Course Name	GEOMECHANICS	Course Category	C	PROFESSIONAL CORE	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:	*create insights in to the soil formation and different properties of soil*
CLR-2:	*study the classification and identification of soil*
CLR-3:	*address the concept of permeability and seepage of soils*
CLR-4:	*explore the consolidation and compaction effect on soil in lab and field*
CLR-5:	*realize the principles of effective stress in saturated soils, various soil conditions and the shear strength of the soils*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*identify the soil formation and various properties of soil*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*analyze the classification of soil*	*3*	*3*	*2*	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*apply permeability and seepage of soils*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*identify the consolidation and compaction effect on soil in lab and field*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*extract the principles of effective stress in saturated soils, various soil conditions and the shear strength of the soils*	*3*	*3*	*2*	-	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Identification of Soils and Functional Relationships ***9 Hour***

Soil formation, Soil types, Definitions: soils, soil mechanics, Scope of soil engineering. Basic Definitions - Soil as two phase and three-phase system - Relationships in terms of weight and volume in phase system - Moisture content, unit weights, degree of saturation, void ratio, porosity, specific gravity. Relationship between volume-weight, void ratio-porosity, void ratio-water content- specific gravity-degree of saturation, unit weights-specific gravity-void ratio–degree of saturation, bulk unit weight–dry unit weight. Determination of various parameters such as: Moisture content by oven dry method, sand bath method, torsional balance method and alcohol method. Specific gravity by density bottle method, pycnometer method. Unit weight by core cutter method, sand replacement method.

Unit-2 - Classification of Soils ***9 Hour***

Necessity, Principles of classification, Plasticity Characteristics of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, plasticity, liquidity and consistency indices, flow and toughness indices, definitions of activity and sensitivity. Determination of: liquid limit, plastic limit and shrinkage limit. Classification of Soils: Methods: - particle size classification, unified soil classification, Indian standard soil classification system. Field identification of soils.

Unit-3 - Permeability and Seepage in Soils ***9 Hour***

Permeability of Soil –Definition, Introduction to hydraulic head, Darcy's law, validity of Darcy's law. Determination of coefficient of permeability: Laboratory method: constant head method, falling head method. Field method: types, pumping- out test – Confined and Unconfined aquifer. Equivalent permeability in stratified soils. Factors affecting permeability. Quick sand condition. Seepage Analysis-Introduction, characteristics of flow nets, uses and application of flow nets.

Unit-4 - Compaction and Consolidation ***9 Hour***

Definition and objectives of compaction. Proctor test and modified proctor test, Concept of OMC and maximum dry density, Zero air voids line. Factors influencing compaction. Effect of compaction on soil properties - Field compaction methods. CBR of soil. Consolidation of Soil-Introduction, comparison between compaction and consolidation, initial, primary and secondary consolidation, spring analogy for primary consolidation, Terzaghi's theory of one-dimensional consolidation partial differential equations (no analytical). Laboratory tests. Determination of coefficient of consolidation – $\sqrt{t}$ and log t methods.

Unit-5 - Shear Strength	***9 Hour***
Stresses in soils, Geostatic stress, Total - Effective and Neutral stress, Fluctuations of effective stress, effective stress in soils saturated by capillary action, seepage pressure. Shear Strength- Mohr's strength and stress circles - Origin of planes - Mohr's envelope - Mohr-Coulomb strength theory. Types of shear test: direct shear test, merits of direct shear test, triaxial compression tests, test behaviour of UU, CU and CD tests, relation between major and minor principal stresses, unconfined compression test, vane shear test. Factors affecting shear strength.	

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. *Arora. K.R, "Soil Mechanics and Foundation Engineering", Standard Publication Distributors, 2011.* 4. *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 Engineering: 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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 2	*Understand*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 3	*Apply*	*30%*	*-*	*30%*	*-*	*30%*	*-*
Level 4	*Analyze*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 5	*Evaluate*	*10%*	*-*	*10%*	*-*	*10%*	*-*
Level 6	*Create*	*-*	*-*	*-*	*-*	*-*	*-*
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. P. Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com*	1. *Dr. M. Muttharam, Anna University muttharam@annauniv.edu*	1. *Dr. P.T. Ravichandran, SRMIST*
2. *Mr. Lenin K.R., Head – GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in*	2. *Dr. V. Murugaiyan, Pondichery Engineering College vmurugaiyan@pec.edu*	2. *Dr. Divya Krishnan K, SRMIST*

Course Code	21CEC205L	Course Name	GEOMECHANICS 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:*
CLR-1:	*study the engineering and index properties of soils*
CLR-2:	*know the compaction and CBR value of soil*
CLR-3:	*explore knowledge on permeability characteristics of soil*
CLR-4:	*address the field density of soil*
CLR-5:	*understand the shear strength of soil and function of triaxial shear test*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*extract the use of sieve, Atterberg's apparatus in determination of soil properties*	*3*	*3*	-	-	-	-	-	-	*3*	-	-	-	*3*	-	*3*
CO-2:	*interpret the OMC and Density to compact and CBR value of soil*	*3*	*3*	-	-	-	-	-	-	*3*	-	-	-	*3*	-	*3*
CO-3:	*analyze the permeability characteristics of various soil*	*3*	*3*	-	-	-	-	-	-	*3*	-	-	-	*3*	-	*3*
CO-4:	*identify the density of soil in-situ*	*3*	*3*	-	-	-	-	-	-	*3*	-	-	-	*3*	-	*3*
CO-5:	*analyze the shear strength of soil and use of triaxial shear test*	*3*	*3*	-	-	-	-	-	-	*3*	-	-	-	*3*	-	*3*

Practice -	***30 Hour***
Practice 1: Moisture content using oven drying method	
Practice 2: Specific gravity of soil grains	
Practice 3: Grain size distribution by sieve analysis.	
Practice 4: Consistency limits - Liquid limit, Plastic limit and Shrinkage limit.	
Practice 5: Permeability - Constant head method.	
Practice 6: Permeability - Falling head method	
Practice 7: Compaction test - Standard Proctor method	
Practice 8: Field density - Core cutter method and Sand replacement method	
Practice 9: Relative density of cohesion less soil	
Practice 10: California Bearing Ratio of soil	
Practice 11: Unconfined compression strength test	
Practice 12: Free swell index test	
Practice 13: Direct shear test	
Practice 14: Triaxial shear test	
Practice 15: Vane shear test	

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 (CLA)*						*Final Examination (0% weightage)*	
		CLA-1 Average of first cycle experiments (30%)		*CLA-2 Average of second cycle experiments (30%)*		*Practical Examination (40%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 2	*Understand*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 3	*Apply*	-	*30%*	-	*30%*	-	*30%*	-	-
Level 4	*Analyze*	-	*30%*	-	*30%*	-	*30%*	-	-
Level 5	*Evaluate*	-	-	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*		-	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. P.Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com*	1. *Dr. M .Muttharam, Anna University, muttharam@annauniv.edu*	1. *Dr. P.T. Ravichandran, SRMIST*
2. *Mr. Lenin K.R., Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in*	2. *. Dr. V. Murugaiyan, Pondichery Engineering College, vmurugaiyan@pec.edu*	2. *Dr. Divya Krishnan K, SRMIST*

Course Code	21CEC206T	Course Name	IRRIGATION AND WATER RESOURCES ENGINEERING	Course Category	C	PROFESSIONAL CORE	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:	*address concepts related to irrigation, methods of applying water to the fields and distribution systems*
CLR-2:	*study the processes involved in hydrological cycle, precipitation and runoff*
CLR-3:	*understand the occurrence, movement and augmentation of groundwater*
CLR-4:	*provide deep understanding of various impounding, diversion and other hydraulic structures*
CLR-5:	*create insights on the importance of reservoirs and their operation*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*appraise soil-water relationships, canal alignment and design of irrigation channels*	*3*	*3*	*2*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*analyze the precipitation and runoff processes*	*3*	*3*	*2*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*discriminate the various aquifer parameters and estimate the yield of groundwater under steady state conditions*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*recognize the importance, features and functions of diversion, impounding and other hydraulic structures*	*3*	*3*	*2*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*perceive the importance of reservoirs and their operation*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Irrigation and Distribution Systems	***9 Hour***
Irrigation – Methods of applying water to the fields – Soil-water-plant relationship – Depth and frequency of irrigation – Crop season – Duty & Delta – Consumptive use – Canal – Types of alignment – Distribution systems – Channel losses – Design of alluvial channels – Kennedy's and Lacey's theory of regime channels.	
Unit-2 - Hydrological Cycle, Precipitation and Runoff Process	***9 Hour***
Hydrologic cycle – Global distribution of water – Precipitation – Forms & Types – Measurement of precipitation – Mean areal depth of precipitation – Estimation of missing precipitation – Design of raingauge network – Probable Maximum Precipitation – Runoff process – Factors affecting runoff – Estimation of runoff – SCS-CN method – Flow duration curve – Flow mass curve	
Unit-3 - Groundwater	***9 Hour***
Occurrence of ground water – Zones of subsurface water – Aquifer parameters – Darcy's Law – Infiltration wells & Infiltration galleries – Open wells & Tube wells – Yield of an open well – Pumping test and Recuperation test – Steady state flow in wells – Dupuit's & Theim's equation – Artificial recharge methods	
Unit-4 - Diversion, Impounding and Other Hydraulic Structures	***9 Hour***
Weirs and Barrages – Diversion head works & its components – Failure of hydraulic structures – Bligh's, Lane's and Khosla's theories – Dams, functions and classification – Functions of galleries – Environmental flows - Functions of canal regulator, cross regulator, canal fall, canal escape and cross drainage works	
Unit-5 - Reservoir Capacity and Operation	***9 Hour***
Reservoir – Classification – Site selection – Storage zones – Storage-Discharge relation – Determination of live storage capacity - Determination of reservoir yield – Reservoir sedimentation – Economic height of a dam – Reservoir operation – Single purpose conservation reservoirs, flood control reservoirs & Multi-purpose reservoirs	

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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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. Shaik Niyazuddin Guntakal, SRMIST*

Course Code	21CEC207T	Course Name	CONCRETE TECHNOLOGY AND SPECIAL CONCRETE	Course Category	C	PROFESSIONAL CORE	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:	*know about concrete characteristics chemical and mineral admixtures used in concrete, also understand about concrete mix design*
CLR-2:	*know about the properties of lightweight, high strength, high performance concrete and ferrocement*
CLR-3:	*know about the self-compacting concrete and ready mixed concrete*
CLR-4:	*know about other special concretes: Fibre reinforced concrete, polymer concrete and blended cement concrete*
CLR-5:	*know about the other special concretes: SIFCON, bacterial concrete, geopolymer concrete, roller compacted, recycled aggregate and reactive powder concrete*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*understand the concrete characteristics evaluate the chemical and mineral admixtures used in concrete and concrete mix design without and with admixtures*	*3*	*2*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*apply the properties of lightweight, high strength, high performance concrete and ferrocement*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*apply the self-compacting concrete and ready mixed concrete*	*3*	*2*	-	-	-	-	-	-	-	-	-	*2*	*3*	-	-
CO-4:	*apply the special concretes: Fibre reinforced concrete, polymer concrete and blended cement concrete*	*3*	*3*	*3*	-	-	*2*	*3*	-	-	-	-	*2*	*3*	-	-
CO-5:	*understand the SIFCON, bacterial concrete, geopolymer concrete, roller compacted, recycled aggregate and reactive powder concrete*	*3*	*1*	-	-	-	-	-	-	-	-	-	*2*	*3*	-	-

Unit-1 - Concrete Characteristics ***9 Hour***

Fresh concrete – workability – workable concrete – affecting factors – workability tests-Segregation – types –favourable conditions – remedies. Bleeding – effects – test Hardened concrete. Density. Compressive strength – affecting factors – test procedure-Flexural strength – Central point load – two-point load tests. Splitting tensile test-Stress-strain curve for concrete Stress - Strain curve for cement paste, aggregate and concrete-Modulus of elasticity of concrete - Different elastic moduli - Test procedure-Shrinkage of concrete - situation leas to shrinkage - Factors affecting shrinkage -Causes for shrinking - Types of Shrinkage in Concrete-Concrete creep Affecting Creep- definition- Factors-Effects of Creep on Concrete-Variability of concrete strength - three component sources - distribution of results- normal distribution curve - mean and standard deviation-Concrete quality control - Importance of quality control - Quality control application in concrete construction-Process of manufacturing of concrete - various stages - Batching methods - Mixing methods-Methods of transportation-Methods of transportation-Compacting - Curing – Finishing Special Concreting Methods-Cold and hot weather concreting-Effects of Cold Weather on Concrete - Different conditions aspect of cold weather concreting - Precautions to be taken-Hot Weather Concreting - Definition- Special problems - Precautions Taken-Vacuum dewatered concrete-Rate of Extraction of Water-Under water concreting – bottom bucket method-Tremie pipe method

Unit-2 - Admixtures & Concrete Mix Design ***9 Hour***

Overview –Chemical and mineral admixtures – additive – plasticizers – definition – situation need high workability– effects of plasticizer in concrete-Super plasticizers – effects in – fresh and hardened concrete-Accelerators – accelerating plasticizer-Retarders proofers–use–materials-Water-Fly ash – characteristics – use –classification –effects in fresh concrete-Fly ash –effects in hardened concrete-Silica fume – characteristics – effects in fresh concrete-Silica fume – effects in hardened concrete-GGBS - effects in fresh concrete-GGBS - effects in hardened concrete –uses-Metakaolin – application-Advantages – uses-Definition – Principle of mix design –Factors choice of mix proportion Properties of concrete related to mix design-Physical properties of materials required for mix design-Nominal and design mix – variables in mix design-Objective of mix design – List of methods of mix design-Basic steps –- Information required for mix design-Indian standard method of mix design- step by step mix design procedure-Mix design example : Without admixture-Mix design admixture-example: With chemical Mix design admixture- example: With mineral admixture

Unit-3 - Lightweight and High Strength Concrete	***9 Hour***
Lightweight concrete – definition – advantages-Classifications of lightweight concrete-Methods for making concrete in lightweight-Lightweight aggregates used in concrete-Natural aggregate-aggregates as lightweight-Artificial aggregates as lightweight aggregate-Industry – domestic – wastes – used in concrete-Agricultural wastes as aggregate in concrete-Use of Oil palm shell in concrete-Coconut shell concrete - Application of lightweight concrete-Design of lightweight concrete mix-Mixing procedure for lightweight concrete production-High Strength Concrete – Definition-Making of high strength concrete in general-Materials used for high strength concrete– Properties Advantages -Disadvantage – Applications of high strength concrete-High performance concrete – Definition-Properties - Classification – uses of high performance concrete-High density concrete – preparation – mixing – placing – application – advantages – disadvantages-High performance concrete - Definition - Properties - Classification – uses-Ferrocement - Differs from conventional concrete - Definition - Materials – Mixing Casting Techniques - Applications and Advantages of ferrocement.	
Unit-4 - Self-Compacting Concrete	***9 Hour***
Definition –Material –Example of mixes-Requirements for self-compacting concrete-Workability requirement for fresh self- compacting concrete-Production and placing-Mix design-Test methods-Slump flow test-T50 Slump flow test-J-ring test-V-funnel test-L-box test-U-box test-Fill box test-GTM screen stability test-Ready mixed concrete – definition – types-Information purchaser to be supplied by the Information to be supplied by the producer-Advantages – Properties-Ready mixed concrete versus site mixed concrete-Limitations	
Unit-5 - Other Special Concretes	***9 Hour***
Fibre reinforced concrete - definition - basic requirements - properties of FRC - factors affecting FRC-Effects of fibre in concrete - Types of FRC- Application of FRC-Polymer impregnated concrete-Polymer cement concrete-Polymer concrete-Partially impregnated surface coated polymer concrete-Properties -Advantages – Applications-Blended cement concrete - Definition - Characteristics – Types-Technical - Environmental advantages – uses-General-Slurry infiltrated fibrous reinforced concrete (SIFCON) - Composition - Process - Design principles-Factors affecting the efficiency of SIFCON- Advantages-Disadvantages-Application-Briefly about Bacterial concrete-Geopolymer concrete-Roller compacted concrete-Smart concrete-Recycled aggregate concrete-Reactive powder concrete.	

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. *Gunasekaran K and Annadurai R. Coconut shell as an aggregate concrete in Concrete, LAMBERT Academic Publishing, Saarbrucken, Germany, 2017.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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 Rural Department, NITTTR, Chennai*	1. *Dr. K.S. Satyanarayanan, 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*	2. *Dr. M. Prakash, SRMIST*

Course Code	21CEC301T	Course Name	STRUCTURAL ANALYSIS	Course Category	C	PROFESSIONAL CORE	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:	*know the behavior of indeterminate structures using slope deflection and moment distribution method*
CLR-2:	*analyze indeterminate structures using energy method, Get exposed to flexibility and stiffness matrix method*
CLR-3:	*explore the behaviour of determinate and indeterminate structures under moving loads*
CLR-4:	*explore the behaviour of arches and suspension cable bridges*
CLR-5:	*know the behavior of indeterminate structures using plastic analysis*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*apply slope deflection and Moment distribution methods to solve beams and frames*	*3*	*3*	-	*2*	-	-	-	-	-	-	-	-	*3*	*3*	-
CO-2:	*apply energy principles to beams, frames and trusses, apply matrix flexibility and stiffness method to solve the indeterminate structures*	*3*	*3*	-	*2*	-	-	-	-	-	-	-	-	*3*	*3*	-
CO-3:	*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*	*2*	*3*	-	*2*	-	-	-	-	-	-	-	-	*3*	*3*	-
CO-4:	*analyze the two hinged and three hinged arches and suspension bridges*	*3*	*3*	-	*2*	-	-	-	-	-	-	-	-	*3*	*3*	-
CO-5:	*apply plastic theory to solve indeterminate beams and frames*	*3*	*3*	-	*2*	-	-	-	-	-	-	-	-	*3*	*3*	-

Unit-1 - Slope Deflection and Moment Distribution Method ***9 Hour***

Degree of kinematic indeterminacy and degrees of freedom of beams, frames and trusses, Introduction and derivation of slope deflection equations, Application of slope deflection method to solve continuous beams up to a degree of indeterminacy of three, Application of slope deflection method to solve continuous beams with settlements, Application of slope deflection method to solve non sway and sway frames. Introduction and development of moment distribution method, Application of moment distribution method to solve continuous beams up to a degree of in determinacy of three, Application of moment distribution method to solve continuous beams with settlements, Application of moment distribution method to solve non sway and sway frames

Unit-2 - Introduction to Energy Methods and Matrix Methods ***9 Hour***

Use of Castigliano's theorem to analyze propped cantilever and fixed beams, Analysis of non-sway and sway frames up to a degree of indeterminacy of two using Castigliano's theorem, Introduction to Unit load method, Analysis of indeterminate trusses up to a degree of indeterminacy of two using unit load method. Concept of flexibility of structures, Derivation of direct flexibility matrix equation, Application of flexibility matrix method to solve propped cantilever, fixed and continuous beam. Advantages of stiffness method over flexibility method. Analysis of propped cantilever, continuous beam using direct stiffness method, Introduction to element stiffness method- coordinate systems – element and global, Derivation of element stiffness matrix for truss, beam, frame elements in local coordinates. Assembling global stiffness matrix for two span continuous beams, partitioning global stiffness matrix and finding the unknown displacements and reactions

Unit-3 - Influence Lines Diagrams and Moving Loads ***9 Hour***

Introduction to influence line diagram (ILD) and Muller Breslau's principle, ILD for BM and SF for cantilever, simply supported, overhanging beams subject to moving point loads and UDL– Introduction to IRC trailer load, Concept of absolute maximum BM in simply supported beams, Finding absolute maximum BM and SF in a simply supported beam subjected to series of moving loads, Finding absolute maximum BM /SF in a simply supported beam subjected to UDL – shorter and longer than the span, ILD of propped cantilevers, ILD for two span continuous beam for end support reaction, mid support reaction, mid support moment, span BM and span shear.

Unit-4 - Arches and Suspension Bridges	***9 Hour***
Introduction to arches – three hinged, two hinged, fixed – Eddy's theorem – theoretical arch, Analysis of three hinged parabolic and circular arches, Analysis of two hinged arches, Introduction to suspension cables, Analysis of suspension cables with UDL – maximum and minimum cable tension and support reactions – resultant (Supports at same and different level), Finding the forces at anchor towers – saddle support with rollers and hinged supports, Introduction to two hinged and three hinged stiffening girders	
Unit-5 - Plastic Analysis of Structure	***9 Hour***
Plastic moment of resistance - Plastic Modulus - Shape factor - Load factor - Plastic Hinge and mechanism - Analysis of indeterminate beams and frames- mechanism method - Introduction to pushover analysis	

Learning Resources	1. *Menon.D, "Structural Analysis",Alpha Science International Limited, 2009.* 2. *Punmia, B.C., Ashok Kumar Jain, Arun Kumar Jain, "Theory of Structures", Laxmi Publications, New Delhi, 12th Edition, 2004.* 3. *Pandit.G.S., Gupta.S.P., "Structural Analysis- A Matrix Approach", 2nd Edition, Tata McGraw-Hill Education, New Delhi,2010*	4. *Bhavikatti.S.S., "Structural Analysis Vol-1", E-3, Vikas Publishing House Pvt Limited, 2009.* 5. *Vaidyanathan.R, "Comprehensive Structural Analysis", Volume 1, Laxmi Publications, New Delhi, 2005.* 6. *Wang.C. K, "Statically Indeterminate Structures", McGraw Hill International Book Company, 1984.* 7. *Harry H.West., "Analysis of Structures", John Wiley &Sons.1980.* *https://nptel.ac.in/courses/105105166*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Er. G.Hariharanath, GA Consultants, Chennai, gac1996ze@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	21CEC301L	Course Name	COMPUTER-AIDED CIVIL 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:***
CLR-1:	*understand the behavior of 2D and 3D moment resistant RC frames using STAAD Pro or ETABS*
CLR-2:	*explore the behavior of plane steel frames using STAAD Pro or ETABS*
CLR-3:	*get insight the calculation of the area of steel of beams using MS Excel program*
CLR-4:	*explore the method of solving matrix equation using stiffness matrix*
CLR-5:	*understand the flexural behavior of RC and Castellated beam, shear and torsional behavior of RC beam*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*report on the behavior of 2D and 3D moment resistant RC frames using STAAD Pro or ETABS*	*3*	*2*	*-*	*3*	*3*	*-*	*-*	*-*	*3*	*-*	*-*	*-*	*3*	*3*	*3*
CO-2:	*analyze the behavior of plane steel frames using STAAD Pro or ETABS*	*3*	*2*	*-*	*3*	*3*	*-*	*-*	*-*	*3*	*-*	*-*	*-*	*3*	*3*	*3*
CO-3:	*calculate the area of steel of beams using MS Excel program*	*2*	*2*	*-*	*2*	*2*	*-*	*-*	*-*	*3*	*-*	*-*	*3*	*3*	*3*	*3*
CO-4:	*solve matrix equation using stiffness matrix*	*3*	*2*	*-*	*3*	*3*	*-*	*-*	*-*	*3*	*-*	*-*	*3*	*3*	*3*	*3*
CO-5:	*analyze the flexural resistance of RC and Castellated beam, shear and torsional resistance of RC beam*	*3*	*2*	*-*	*3*	*3*	*-*	*-*	*-*	*3*	*-*	*-*	*-*	*3*	*3*	*3*

Practice -	***30 Hour***
Practice 1: Analysis of 2D and 3D moment resistant RC frames using STAAD Pro or ETABS for real building model	
Practice 2: Analysis of Plane pin jointed steel frames using STAAD Pro or ETABS	
Practice 3: Analysis in STAAD Pro or ETABS for moving IRC loads and verification	
Practice 4: Programming in MS Excel for the calculation of A_{st} for singly reinforced beam by LSM	
Practice 5: Solving matrix problems in MS Excel	
Practice 6: Study on the behavior of RC and Castellated beam under flexure	
Practice 7: Study on the behavior of RC beam under shear	
Practice 8: Study on the behavior of RC beam under torsion	
Practice 9: Demonstration of stress analysis using Photoelasticity principle	
Practice 10: Demonstration of base exciter for seismic analysis	

Learning Resources	1. *IS 456:2000, Plain and Reinforced Concrete: Code of Practice, Bureau of Indian Standards, New Delhi?*	2. *Laboratory Manual for computer aided structural analysis laboratory - SRMIST*

Learning Assessment									
	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*						*Final Examination (0% weightage)*	
		CLA-1 Average of first cycle experiments (30%)		*CLA-2 Average of second cycle experiments (30%)*		*Practical Examination (40%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 2	*Understand*	-	*20%*	-	*20%*	-	*20%*	-	-
Level 3	*Apply*	-	*30%*	-	*30%*	-	*30%*	-	-
Level 4	*Analyze*	-	*30%*	-	*30%*	-	*30%*	-	-
Level 5	*Evaluate*	-	-	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*			

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	21CEC302T	Course Name	STRUCTURAL ENGINEERING DESIGN-II	Course Category	C	PROFESSIONAL CORE	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:	*explore the behavior of tension member*
CLR-2:	*analysis the behavior of connection design*
CLR-3:	*analysis the behavior of compression member*
CLR-4:	*understand the behavior of beams*
CLR-5:	*gain knowledge on the behavior of light gauge steel*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*understand basics of limit state design, code provisions and to design tension members*	*3*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*	*-*
CO-2:	*design connections*	*3*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*	*-*
CO-3:	*design steel members subjected to compression*	*3*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*	*-*
CO-4:	*design simple and built-up beams*	*3*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*	*-*
CO-5:	*design light gauge steel sections*	*3*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*	*-*

Unit-1 - Introduction and Tension Members	***9 Hour***
Types of Steel Structures - Properties of Structural Steel, Indian Standard Specifications and sections Design criteria as per IS800:2007Analysis methods- Calculation of Loads as per IS codes Design Philosophy- Introduction to Limit State Method of design – Partial safety factor- general design requirements as per I S800:2007 Design provisions of Tension members Design of simple tension members -Effective net area- Types of failures Design of Plates with holes subjected to tension Design of Angles subjected to tension design of built-up members - Tension splices	
Unit-2 - Connections	***9 Hour***
Types of Connections-Bolted and Welded connections - types of bolts and welds Load transfer mechanism- failure of joints -permissible stresses Design of Pin Connections-Design of lap joints Design of butt joints Design of Truss joint	
Unit-3 - Compression Members	***9 Hour***
Compression member design -Design provisions Effective length-Slenderness ratio-Types of buckling-Classification of cross-sections Design of simple columns Design of built up columns -Types Design of lacing Design of batten	
Unit-4 - Beams	***9 Hour***
Behavior of Steel members in flexure Design of simple beams Phenomenon of Web Buckling and Web Crippling- Design provisions Lateral Torsional Buckling behavior of unrestrained beams Check for Lateral Torsional Buckling of unrestrained beams Design of beams subjected to Biaxial Bending Design of built-up beams	
Unit-5 - Light Gauge Steel Sections	***9 Hour***
Design of light gauge steel members-design provisions Local and post buckling behavior of thin element of light gauge steel sections Design of light gauge steel compression members Design of light gauge steel tension members Design of light gauge steel beams Design of connections	

Learning Resources	1. *Subramanian.N, "Design of Steel Structures-Limit State Method", Oxford University Press,New Delhi, 2016* 2. *Duggal. S.K, "Limit State Design of Steel Structures", Tata McGraw Hill Publishing Company, New Delhi, 2010.* 3. *Reference Books/Other Reading Material* 4. *Gaylord, E.H., Gaylord,N.C., and Stallmeyer,J.E., "Design of Steel Structures", McGraw Hill Pub.,1992.* 5. *Ramamrutham .S. "Design of Steel Structures", Dhanpat Rai Pub., 2013.*	6. *Vazirani. V.N, "Design and Analysis of Steel Structures", Khanna Publishes, 2003.* 7. *Ramachandra. S , Virendra Ghelot, "Limit State Design of Steel of Structures", Scientific Publishers, New Delhi, 2012.* 8. *Arya.A.S. & Ajmani.J.L., "Design of Steel Structures", Nemchand & Bros., 2011.* 9. *Dayarathnam. P, "Design of Steel Structures", S.Chand and Company Ltd. , 2008* 10. *Kazimi. S. M. A. and Jindal. R. S., "Design of Steel Structures", 2nd Edition, Prentice Hall of India,1988*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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.R.Ravi, 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.M.Prakash, SRMIST*

Course Code	21CEC303T	Course Name	TRANSPORTATION ENGINEERING	Course Category	C	PROFESSIONAL CORE	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 concepts in the geometric design of highway and learn the needs and concepts in horizontal and vertical alignment of highway
CLR-2:	learn the various traffic studies required for traffic management
CLR-3:	comprehend the design of various infrastructure facilities required for the traffic
CLR-4:	explore the material requirement of flexible pavement and design the pavement
CLR-5:	know the components of rigid pavement and its design

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	design the geometric cross-section of highway, horizontal and vertical alignment of highway	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO-2:	apply various traffic studies and analysis the volume and speed data	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO-3:	plan and design the various infrastructure facilities required for the traffic	2	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO-4:	discriminate the material and the design the structure of flexible pavement	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-
CO-5:	analyze and design the structure of rigid pavement	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-

Unit-1 - Highway Geometric Design **9 Hour**

Elements of transportation engineering - Highway planning and alignment - Classification of rural and urban roads - Cross sectional elements of roads, Terrain classification, speed and geometric standards for different terrain - Sight Distance, stopping sight distance, overtaking sight distance and intersection sight distance – Design of horizontal alignment, circular curve radius, superelevation, attainment of superelevation, extra-widening, set back distance, transition curve length, reverse and compound curve. Design of vertical alignment, summit and valley curve.

Unit-2 - Traffic Studies **9 Hour**

Fundamental traffic parameters, speed, density, volume, travel time, headway, spacing, time mean speed, space mean speed - Spot speed study - Traffic volume study - Moving observer method - Parking study and demand analysis - Accident spot analysis

Unit-3 - Traffic Facilities Design **9 Hour**

Traffic signs and road markings - Channelization of traffic and channelization layouts - Traffic rotary, design elements, capacity of rotary - Grade separated intersection, warrants and types, layout of grade separated intersection - Elements of traffic signal, headway, saturation flow, design principles of a traffic signal, phase design, cycle time determination, green splitting, design of two phase and three phase signal - Signal co-ordination, determination of bandwidth

Unit-4 - Flexible Pavement **9 Hour**

Component of flexible pavement, Functions of each component - Materials - Basic properties of bitumen, Binder grade and classification, Soil and aggregate properties, Resilient modulus of aggregate and soil, bituminous concrete mix properties, types of bituminous concrete mix, bituminous concrete mix design - Flexible pavement design, traffic factor, equivalent single wheel load and standard axle load, truck factor, vehicle damage factor ,number of repetition of standard axle load, design of pavement with unbounded and bonded layers.

Unit-5 - Rigid Pavement Design	***9 Hour***
Components of rigid pavement - Details of joints - Stresses in rigid pavement, temperature stress, wheel load stress, stress combinations and critical stress - Thickness of rigid pavement - design of joint spacing - Dowel bar design - Design of dowel bars - Check for the adequacy of dowel bars - Design of tie bars - 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 10thedition, 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. *6. Yang Huang, Pavement Analysis and Design, Pearson, 2004*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com*	1. *Dr. Venkaiah Chowdary, Professor, NITW, vc@nitw.ac.in*	1. *Dr. A. Padma Rekha, SRM IST*
2. *Mr. Ankit Pachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org*	2. *Dr. V Sunitha, Associate Professor, NITT, sunitha@nitt.edu*	2. *Mr. G. Sivaprakash, SRM IST*

Course Code	21CEC303L	Course Name	TRANSPORTATION 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:*
CLR-1:	*learn the methodology used to measure traffic volume count and categorize different mode of traffic at straight road and intersection*
CLR-2:	*understand the travel time and speed characteristics and study the parking characteristics*
CLR-3:	*measure the properties of bitumen and aggregates*
CLR-4:	*explore the proportioning of aggregate*
CLR-5:	*comprehend the volumetric and strength of bituminous mixture*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*evaluate the vehicular composition in the straight road and intersection*	*3*	*2*	-	-	-	-	-	-	*3*	-	-	-	*3*	*3*	*3*
CO-2:	*analyze the travel time and speed characteristics and design the parking area*	*3*	*2*	-	-	-	-	-	-	*3*	-	-	-	*3*	*3*	*3*
CO-3:	*grade the bitumen and select the aggregate for the preparation of bituminous mixture*	*3*	*2*	-	-	-	-	-	-	*3*	-	-	-	*3*	*3*	*3*
CO-4:	*design the aggregate gradation for bituminous mixture*	*3*	*2*	-	-	-	-	-	-	*3*	-	-	-	*3*	*3*	*3*
CO-5:	*design the bituminous mixture mix proportion*	*3*	*2*	-	-	-	-	-	-	*3*	-	-	-	*3*	*3*	*3*

Practice –	***30 Hour***
Practice 1: Determination of vehicular composition in uninterrupted traffic stream	
Practice 2: Determination of vehicular composition in interrupted traffic stream	
Practice 3: Determination of instantaneous spot speed of vehicles	
Practice 4: Determination of traffic stream parameters by moving observer method	
Practice 5: Evaluation of on street parking characteristics	
Practice 6: Evaluation of off-street parking characteristics	
Practice 7: Determination of specific gravity of bitumen	
Practice 8: Determination of the penetration value of bitumen	
Practice 9: Determination of softening point of bitumen	
Practice 10: Determination of viscosity of bitumen	
Practice 11: Determination of ductility of bitumen	
Practice 12: Performance grading of bitumen – demo / Batching of aggregates	
Practice 13: Determination of specific gravity aggregates	
Practice 14: Preparation of bituminous mix and measure of mixture volumetric properties	
Practice 15: Marshall stability test and design of bituminous mix	

Learning Resources	1. S. K Khanna, C E G Justo, A Veeraraghavan, Highway Engineering, Nem Chand and Bros 2. IS 73: 2018, Paving Bitumen - Specification, 4th Revision, BIS, New Delhi	3. IS 15462:2019, 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 (CLA)						Final Examination (0% weightage)	
		CLA-1 Average of first cycle experiments (30%)		CLA-2 Average of second cycle experiments (30%)		Practical Examination (40%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	20%	-	20%	-	20%	-	-
Level 2	Understand	-	20%	-	20%	-	20%	-	-
Level 3	Apply	-	30%	-	30%	-	30%	-	-
Level 4	Analyze	-	30%	-	30%	-	30%	-	-
Level 5	Evaluate	-	-	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-		-
	Total	100 %		100 %		100%		-	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com	1. Dr. Venkaiah Chowdary, Professor, NITW, vc@nitw.ac.in	1. Dr. A. Padma Rekha, SRM IST
2. Mr. Ankit Pachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org	2. Dr. V Sunitha, Associate Professor, NITT, sunitha@nitt.edu	2. Mr. G. Sivaprakash, SRM IST

Course Code	21CEC304T	Course Name	CONSTRUCTION ENGINEERING AND MANAGEMENT	Course Category	C	PROFESSIONAL CORE	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:	*identify the basic requirements for planning the construction project*
CLR-2:	*calculate the resources required for construction project*
CLR-3:	*analyze the competence to determine the total project duration*
CLR-4:	*generate building information model*
CLR-5:	*select the applications of emerging technologies for construction project management problems*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*describe the fundamental requirements of typical construction project*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	*3*	-	*3*
CO-2:	*examine the requirement of construction resources*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	*3*	-	*3*
CO-3:	*predict the construction time management*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	*3*	-	*3*
CO-4:	*develop building information model*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	*3*	-	*3*
CO-5:	*evaluate the results from emerging technologies for construction management problems*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	*3*	-	*3*

Unit-1 - Construction Planning	***9 Hour***
Construction engineering and management history, Basics of construction - unique features of construction, Construction projects types and features, phases of a project, Project life cycle- Contracts and types, Bidding process- Time value of money, NPV- Construction drawing, elements, types, reading skills required, essential aspects of National Building Code - International standards for project management – Project Management Body of Knowledge and IS/ISO 21500:2015 guidelines on project management.	
Unit-2 - Resource and Safety Management	***9 Hour***
Construction project estimation, types, methods, basic terms, quantity calculations, advanced tools for estimations- Resource management, Types of resources, Characteristics of resources - Estimation of resources- Manpower, Classes of labour, labour productivity- Quality control, quality assurance, Quality gurus – Safety management, health and environment on project sites - Material, Relevant Indian standards for the construction materials, functions of material management, inventory cost, ABC analysis, EOQ model – Equipment, classification of construction equipment, Factors for the selection of construction equipment.	
Unit-3 - Time Management	***9 Hour***
Scheduling methods for construction project – Critical path method (numerical problem)- Computation of float values -Program Evaluation Review Technique (numerical problem), Critical chain method, and Line of Balance method- Resource allocation, Resource scheduling - bar chart, line of balance technique, Resource constraints and conflicts, Resource smoothening and levelling concepts.	
Unit-4 - Construction Automation	***9 Hour***
Geo-informatics in Construction Management - Automation – Positioning, Progress monitoring, Quality control - Construction project performance indicators - Tracking, Unmanned Aerial System (UAS) applications in the built environment - Influence of Technology, Building Information Modelling, BIM Components, Applications of BIM, Necessity of BIM Technology and The Role of Facility Management, Virtual Reality in Construction Management, 4D Simulation, Lean Tools for Construction industry, Lean Implementation, Challenges Barriers in implementation of Lean – Case studies.	

Unit-5 - Emerging Technologies	***9 Hour***
Energy efficient buildings for various zones, classification of Indian climates, Green Globe, LEED certification Guidelines, GRIHA, IGBC certifications and standards - Smart Cities, Necessity, guidelines-Industrial Internet of Things, Building occupancy sensors and actuators – 3D concrete printing, Essentials, Process, advantages - Optimization techniques for construction engineering and management problems, Applications of machine learning, Applications of neural networks - Futuristic perspective of construction engineering and management - Case studies	

Learning Resources		
	1. *Construction Project Management: Theory and Practice, 2015, Kumar Neeraj Jha, Pearson publication.* 2. *National Building Code, 2016, Bureau of Indian Standards* 3. *Manual for procurement of goods, 2022, Ministry of Finance, Department of Expenditure, Government of India* 4. *Analysis of Rates for Delhi, Vol -1, 2021, Central Public Works Department, Authority of Director General, New Delhi, Government of India.*	5. *Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th Ed.). Project Management Institute.* 6. *IS/ISO 21500:2012 Guidance on project management, Bureau of Indian Standards* 7. *Artificial Intelligence with Python, 2017, Prateek Joshi, packt publication.* 8. *Online course: Project Planning & Control, By Prof. Koshy Varghese, IIT Madras, Swayam* 9. *Online course: Construction Management Specialization, offered by Columbia University, Coursera* 10. *Online course: BIM Application for Engineers, offered by National Taiwan University, Coursera*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. C B Amarnath, Expert strategist, LnT pvt,ltd, chennai. amar.changeagent@gmail.com*	1. *Dr. S. Geetha, Professor, Department of Civil Engineering, Rajalakshmi Engineering College, Chennai,*	1. *Dr. L. Krishnaraj, SRMIST*
2. *Mr. Dhanasekar, Project Manager, NEXUS Castles, pvt ltd, Chennai. nexuscastles@gmail.com*	2. *Dr. K. Yogeswari, Professor, Department of Civil Engineering, School of infrastructure, B.S.A. crescent Institute of Science and Technology,*	2. *Dr. S. Gopinath, SRMIST*

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SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

ACADEMIC CURRICULA

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Regulations 2021

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

Course Code	21CEE301T	Course Name	FOUNDATION ENGINEERING AND DESIGN	Course Category	E	PROFESSIONAL ELECTIVE	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:	*study the essential steps involved in a Geotechnical Investigation*
CLR-2:	*comprehend the types of foundation and understand the bearing capacity of shallow foundation*
CLR-3:	*explore the cause and remedial measures for settlement and slope failure*
CLR-4:	*study the load carrying capacity of pile foundation in the field condition*
CLR-5:	*understand the concept of earth pressure*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*identify the soil characteristics through geotechnical investigation*	*3*	*2*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*compute the bearing capacity of shallow foundation depending upon the soil condition*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*analyze measures for reducing the settlement and slope failure*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*apply the proper type of pile in the field*	*3*	*3*	*2*	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*estimate earth pressure for different soil condition*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Site Investigation and Selection of Foundations	***9 Hour***
Introduction– Site Investigation – Planning and stages in investigation - Objectives of soil exploration - Methods of exploration – Direct methods – Semi direct Methods. Borings – Indirect Method. Geophysical methods - Penetration tests (SPT & SCPT) - Depth of exploration - Number and disposition of bore holes - Sampling and sample disturbance – Bore Log Details	
Unit-2 - Bearing Capacity	***9 Hour***
Bearing capacity - Modes of Shear failures – Bearing capacity determinations - Methods. Terzaghi's formula - Skempton's formula - BIS formula - Effect of water table - Allowable bearing pressure - Bearing pressure based on SPT value - Plate load test - Methods of improving bearing capacity.	
Unit-3 - Footings and Rafts	***9 Hour***
Foundations - Types of foundation – Shallow Foundation – Classification - Method of proportioning - Design of combined footing – Rectangular and Trapezoidal Footing Problems - Raft foundation - Codal provisions - Components of settlement – Total and differential settlement - Causes of settlement - Method of minimizing settlement - Codal provisions.	
Unit-4 - Pile Foundation	***9 Hour***
Function of piles - Classification of pile - Load carrying capacity - Static and dynamic formulae - Pile load test - Pile group – Efficiency - Spacing - Pile cap - Negative skin friction. Introduction to well foundations - Diaphragm walls.	
Unit-5 - Earth Pressure	***9 Hour***
Lateral earth pressure - Coulomb's theory - Rankine's theory - Soil stratification - Cohesive and Cohesionless soil - Graphical method (Culmann's method alone) - Stability of slopes - Infinite and finite slopes - Types of failure - Causes of failure - Slip circle methods - Friction circle method	

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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*25%*	-	*25%*	-
Level 4	*Analyze*	*30%*	-	*25%*	-	*25%*	-
Level 5	*Evaluate*	-	-	*10%*	-	*10%*	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. P. Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com*	1. *Dr. M. Muttharam, Professor, Anna University, Chennai*	1. *Dr. P.T. Ravichandran, SRMIST*
2. *Mr. Lenin K.R., Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in*	2. *Dr. V. Murugaiyan, Professor, Pondicherry Engineering College, Pondichrery*	2. *Ms. V. Janani, SRMIST*

Course Code	21CEE302T	Course Name	GEOTECHNICAL DESIGN	Course Category	E	PROFESSIONAL ELECTIVE	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:	*know the concept of consolidation and the estimation of pre-consolidation pressure*
CLR-3:	*study the stress strain behavior of different types of soil*
CLR-4:	*compute the ultimate load carrying capacity of shallow foundation under different field condition*
CLR-5:	*explore the pile load capacity and settlement of single and group of piles in the civil engineering field*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*analyze the soil properties based on geotechnical investigation*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*utilize the pre-consolidation pressure for determining the rate of consolidation*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*interpret the stress strain behavior of soil in the field*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*analyze the ultimate load carrying capacity of shallow foundation*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*design the ultimate load carrying capacity of pile foundation*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Subsurface Investigation	***9 Hour***
Planning of subsurface investigation - Purpose and scope - Influence of soil conditions on exploratory program - Type of foundation on exploratory program - Subsurface soundings – Static methods - Subsurface soundings – Dynamic methods - Planning of subsurface investigations - Type and sequence of operations - Lateral extent and depth of exploration.	
Unit-2 - Consolidation	***9 Hour***
Interpretation of field and laboratory data - Derivation of Terzaghi's equation (solution in detail need not be covered) - Estimation of Cc and Cv from laboratory tests - Estimation of Pc by various methods- Field consolidation curves- Quasi pre-consolidation- Quasi Secondary consolidation- Practical applications.	
Unit-3 - Stress and Strain Behavior of Soil	***9 Hour***
Concepts - Triaxial test - Drained and un-drained behavior of sand - Triaxial test - Drained and un-drained behavior of clays - Failure criteria in soils – Only Mohr – Coulomb's criteria - Ideal, plastic and real soil behavior - Shear strength of sand and clays - Estimation of stresses: Boussinesq's theory - Estimation of stresses: Westergard's theory - Estimation of stresses: Newmark's charts	
Unit-4 - Bearing Capacity and Settlement Analysis of Shallow Foundations	***9 Hour***
Modes of failure of shallow foundations- Failure criteria, Prandtl Reissner Method, assumptions - Estimation of ultimate loads - Terzaghi solution, assumptions - Estimation of ultimate loads - Estimation of ultimate loads - Effect of shape - Estimation of ultimate loads - embedment of footing - Estimation of ultimate loads - Eccentricity in loading - Compressibility (including critical rigidity index), Choice of factor of safety, Settlement of foundations on sand – Schmertmann method - Foundations on collapsing and swelling soils, non-uniform soils, compressible soils and on rock - Design of isolated and combined footings.	
Unit-5 - Pile Foundations	***9 Hour***
Functions and types of pile foundations - Pile load tests, Use of load tests - Methods of estimation of pile load capacity - Static and dynamic - Estimation of single pile capacity by static - Estimation of single pile by dynamic methods - Group capacity of piles - Separation of skin friction and end bearing capacity - 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 Publishers and 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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. P.Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com*	1. *.Dr.M.Muttharam, Anna University, muttharam@annauniv.edu*	1. *Dr. P.T.Ravichandran, SRMIST*
2. *Mr.Lenin K.R., Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in*	2. *.Dr.V.Murugaiyan, Pondichery Engineering College, vmurugaiyan@pec.edu*	2. *Ms. S.Mary Rebekah Sharmila, SRMIST*

Course Code	21CEE303T	Course Name	GROUND IMPROVEMENT TECHNIQUES	Course Category	E	PROFESSIONAL ELECTIVE	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 need for ground improvement*
CLR-2:	*know the techniques adopted for ground improvement with respect to hydraulic modification*
CLR-3:	*realize the 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:	*explore the mechanism and concept related to soil modification by reinforcements*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1 Engineering Knowledge	2 Problem Analysis	3 Design/development of solutions	4 Conduct investigations of complex problems	5 Modern Tool Usage	6 The engineer and society	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*gain a thorough knowledge on the role of ground improvement techniques in the infrastructure development*	*3*	*2*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*-*	*-*
CO-2:	*recommend hydraulic modification techniques for related problems*	*3*	*2*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*-*	*-*
CO-3:	*apply densification techniques for loose sand deposits and alternative techniques for soft clay deposits*	*3*	*2*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*-*	*-*
CO-4:	*analyze the additives and frame soil chemical modification schemes for stabilizing problematic soil*	*3*	*2*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*-*	*-*
CO-5:	*design geotechnical structures using reinforcements like reinforced earth retaining walls, slopes, foundations etc.,*	*3*	*3*	*-*	*2*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*-*	*-*

Unit-1 - Ground Improvement Techniques ***9 Hour***

Introduction- Role of ground improvement techniques in foundation engineering - Objectives and scope of ground improvement techniques - Classification of techniques adopted - Hydraulic-Mechanical - Chemical-Reinforcement - Choice of method of ground improvement techniques - Geotechnical problems in Lateritic soil - Properties and behavior and techniques adopted- Geotechnical problems in Alluvial soil - Properties and behavior and techniques adopted - Geotechnical problems in Black Cotton soil - Properties and behavior and techniques adopted- Selection of suitable ground improvement techniques based on soil condition - Some field conditions for practical applicability - Use of Piezometers - Field applications - Use of inclinometers - Field applications

Unit-2 - Hydraulic Modification ***9 Hour***

Concept and principle - Dewatering - objectives – types - Dewatering techniques - Well points system - Installation - Mechanism and suitability of soil - Dewatering methods – Ditches - Dewatering methods – Sumps - Vacuum method - Electro osmotic method - Seepage analysis of 2-dimensional flow-concepts - Theory and problems - Seepage analysis –Fully penetrated slot- Theory and problems - Preloading-concept - Field applicability - Vertical drains-sand drains - Installation and mechanism - Prefabricated vertical drains - Installation and mechanism

Unit-3 - In-Situ Densification of Cohesionless Soil ***9 Hour***

Various methods and mechanism involved - Consolidation of cohesive soil-types - Properties and behavior - Vibrofloatation techniques - Dry feed method-wet feed method - Sand compaction piles - Installation techniques - Deep compaction - Dynamic compaction - Blasting technique - Concepts and factors influencing - Stone columns – Installation – Mechanism - Design criteria- Stone column - Soil criteria-field application - Lime columns – Applicability - Soil criteria-mechanism involved - Field application.

Unit-4 - Grouting ***9 Hour***

Introduction - Necessity types of grout-suspension-solution grouts - Functions of grouting-permeation - Functions-Compaction-hydro fracture- Grouting equipment and methods- Grouting with soil, bentonite- Grouting with cement mixes - Mechanism and concept - Grout injection methods - Grout monitoring schemes- Civil engineering application of grouting techniques - Field studies- Stabilization – Concept - Stabilization of expansive soil - Lime stabilization-concept-suitability criteria - Mechanism involved - Cement stabilization – concept - Suitability criteria- Mechanism involved

Unit-5 - Soil Reinforcement	***9 Hour***
Concepts - Principle and mechanism - Reinforced earth retaining structures - Various applicability in geotechnical engineering - Embankments - Slopes etc..- Types of reinforcing materials- Natural and manmade materials – Geosynthetics - Types – Geotextile – Geogrids – Geonets - Functions of geosynthetics - Filtration, drainage - Filtration, drainage - Geosynthetics-Reinforcement - Separation function - Geotechnical field application – Geomembranes - Containments – Barriers - Field application - Current practices – Geosynthetics - Field application reinforcement- Geosynthetics in field applications - 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, First Edition, 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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. P.Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com*	1. *Dr.M. Muttharam, Anna University, muttharam@annauniv.edu*	1. *Dr. P.T.Ravichandran, SRMIST*
2. *. Mr. K.R. Lenin Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in*	2. *Dr.V. Murugaiyan, Pondichery Engineering College, vmurugaiyan@pec.edu*	2. *Ms. S.Mary Rebekah Sharmila, SRMIST*

Course Code	21CEE304T	Course Name	FOUNDATION ON EXPANSIVE SOIL	Course Category	E	PROFESSIONAL ELECTIVE	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 occurrence and distribution of expansive soils*
CLR-2:	*explore the properties of expansive soils*
CLR-3:	*study the various methods of prediction of heave*
CLR-4:	*understand the design procedure for foundation on expansive soils*
CLR-5:	*know the various methods of stabilization used in expansive soils*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*gain a thorough knowledge on the occurrence and distribution of expansive soils*	*3*	-	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*identify the soil characteristics through soil identification*	*3*	*2*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*analyze proper measures for heave prediction*	*3*	*2*	*2*	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*design the suitable type of foundation on expansive soils*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*analyze the additives and soil chemical modification schemes for stabilizing problematic soil*	*3*	-	-	-	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Geotechnical Problem ***9 Hour***

Introduction- Expansive soils an overview - Occurrence of expansive soil - Distribution of expansive soil - Nature of expansive soil with moisture content - Environmental interaction - Physical properties of expansive soils - Effect of expansive soils on structures - Problems and Remedies of expansive soils-Identification of expansive soils - Assessment of Expansion Potential - Moisture equilibrium - concept-Stable and unstable zone-Shrink - swell potential of expansive soil - Field conditions that favour swelling - Consequences of swelling - Distress symptoms - Damage on Foundations from Expansive Soils - Factors influencing swelling and shrinkage of soils.

Unit-2 - Expansive Soil Properties ***9 Hour***

Soil structure - Coarse grained soil - Soil structure - Fine grained soil - Composite structure - Specific surface - Adsorbed and absorbed water - Field exploration methods soils - Sounding test-Identification of expansive - Laboratory methods - Atterberg limit – CEC - Swelling characteristics - Laboratory tests-Swell potential identification from - Atterberg limit, Casagrande's PI-LL Chart - Swell potential identification from Activity index and particle size - Differential free swell - Classification using engineering properties - Swell Pressure measurement - Analysis on swell pressure - Isomorphous substitution - Diffused double layer of water - Specific surface area

Unit-3 - Heave Prediction ***9 Hour***

Clay mineralogy - Types of Clay minerals - Basic structural unit - Synthetization of clay mineral-Properties and characterisation of clay minerals - Mineralogical methods - X-Ray diffraction - Differential Thermal Analysis - Electron microscopy - Potential Volume Change - Expansion Index Test Coefficient of Linear Extensibility (Cole) - Methods of prediction of heave - Empirical methods - Soil suction - Osmotic and matric-Measurement of soil suction – Methods –Tensiometer - Axis translation – Psychrometers - Filter paper method - Thermal Matric Potential Sensors

Unit-4 - Foundation Design	***9 Hour***
Design alternatives - Structural Alternatives - Soil Alternatives - Isolation of structure from soil-Recommendations for type of foundation in expansive soils - Design consideration - Continuous footings-Stiffened mats - Codal provisions.- Under reamed piles – Design - Under reamed piles construction - Advantages and disadvantages of Under reamed piles - Double underreamed pile - Load test on Under reamed pile - Estimation of load carrying capacity from underreamed pile - Belled piers - Bearing capacity and skin friction - Advantages and disadvantages of belied piers - Stiffened slab on grade - Drilled pier and beam - Underpinning method.	
Unit-5 - Stabilization	***9 Hour***
Methods Controlling Swelling characteristics of expansive soil - Prewetting; Surface and subsurface drainage -Treatment of expansive soils - Surcharge loading -Concept Moisture barriers - Horizontal moisture barriers - Moisture barriers - Vertical moisture barriers - Soil replacement with compaction control - Soil Stabilisation - Concept; Mechanical stabilization - Types and concept - Chemical stabilization - Cement stabilization - Advantages and disadvantages - Lime stabilization - Mechanism involved and its limitations - Bituminous stabilization - Thermal stabilization - Thermal Technique – Concept - Thermal stabilization - Freezing Technique – Concept - Industrial waste in soil stabilization - Use of fly ash in soil stabilization - Types of fly ash – Characteristics -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. *Parched..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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*25%*	-	*20%*	-
Level 4	*Analyze*	*30%*	-	*25%*	-	*20%*	-
Level 5	*Evaluate*	-	-	*10%*	-	*20%*	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. P. Selvanambi, Divisional Engineer (Highways), sundariselvam@yahoo.com*	1. *Dr. M. Muttharam, Professor, Anna University, Chennai*	1. *Dr. P.T. Ravichandran, SRMIST*
2. *Mr. Lenin K.R., Head –GEOTECH, SECON Private Limited, Bangalore, lenin.kr@secon.in*	2. *Dr. V. Murugaiyan, Professor, Pondicherry Engineering College, Pondichrery*	2. *Ms. V. Janani, SRMIST*

Course Code	21CEE305T	Course Name	SOLID AND HAZARDOUS WASTE MANAGEMENT	Course Category	E	PROFESSIONAL ELECTIVE	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:	*study the various sources and classification of solid and hazardous waste*
CLR-2:	*know the concepts related to waste characteristics and source reduction*
CLR-3:	*realize insights to the storage, collection and transport of waste*
CLR-4:	*explore the concepts related to waste processing technologies*
CLR-5:	*understand concepts related to waste disposal*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*diagnose the various sources of solid and hazardous waste*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-
CO-2:	*identify the options for reduction, reuse and recycling of waste*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-
CO-3:	*analyze the collection and transport of solid and hazardous waste*	*3*	-	-	-	*2*	-	*3*	-	-	-	-	-	*3*	-	-
CO-4:	*recognize the various waste processing techniques*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-
CO-5:	*detect the waste disposal methods and management*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-

Unit-1 - Sources and Classification	***9 Hour***
Sources of solid waste - Types of solid waste - Hazardous Waste - Identification & Classification - Need for solid and hazardous waste management - Elements of integrated waste management - Role of stakeholder's, public and NGO's - Public health and environmental impacts - Salient features of Indian legislations on management and handling of municipal solid waste, Hazardous waste, Biomedical waste, electronic waste - Case Study: Status of Waste Generation in Bangalore	
Unit-2 - Waste Characterization and Source Reduction	***9 Hour***
Waste generation rates and variation - factors affecting waste generation rate and composition – waste sampling and characterization – Physical, Chemical and Biological properties of solid waste - Hazardous waste characteristics - Source reduction of waste and waste exchange – Recycling – Reuse – Case study: Practices in household waste management	
Unit-3 - Storage, Collection and Transport of Waste	***9 Hour***
Segregation of waste at source - Storage of municipal solid waste - Materials used for containers - Collection of municipal solid waste – Methods, Collection vehicles, Manpower, Collection routes - Analysis of collection systems using software - Transfer stations - Hazardous waste-storage, collection, Transfer and transport	
Unit-4 - Waste Processing Technologies	***9 Hour***
Objectives of waste processing - material separation technologies in solid waste - Physical processing equipment - Chemical conversion technologies - Biological conversion technologies - methods of composting – Factors affecting the composting - Thermal conversion technologies - energy recovery – Incineration - Hazardous waste treatment - Pollution prevention and waste minimization - Hazardous wastes management in India	
Unit-5 - Waste Disposal	***9 Hour***
Waste disposal options for solid and hazardous waste – Landfill – Types and methods – Site selection - Design and operation of sanitary landfills - Landfill liners and covers - Leachate management - Landfill gas management - Environmental monitoring - Landfill closure - Landfill remediation - Rehabilitation of open dumps	

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 Organization, 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 (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

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	1. Mr. D. Justus Reymond, SRMIST
2. Mr. A. Abdul Rasheed, CMWSS Board, juruterarasheed@gmail.com.	2. Dr. G. Dhinagaran, Assistant Professor, CES, Anna University, twinsdina@gmail.com	2. Mr. K. C. Vinuprakash, SRMIST

Course Code	21CEE306T	Course Name	AIR AND NOISE POLLUTION CONTROL	Course Category	E	PROFESSIONAL ELECTIVE	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:	*know the various sources of air and noise pollution*
CLR-2:	*understand the effect of air and noise pollution*
CLR-3:	*explore the air and noise pollution monitoring techniques*
CLR-4:	*study the concepts related to reduce air pollution*
CLR-5:	*realize the concepts related to reduce noise pollution*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*identify the various sources of air and noise pollution*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-
CO-2:	*analyze air quality parameters and its impact*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-
CO-3:	*recognize the pollution measurement methods*	*2*	-	-	-	-	*2*	*2*	-	-	-	-	-	*3*	-	-
CO-4:	*identify the techniques to reduce air pollution*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-
CO-5:	*apply the concept of reducing air and noise pollution*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	-	-

Unit-1 - Air Pollution — ***9 Hour***

Air pollutants, sources, classification-Monitoring techniques for air and noise pollution-Combustion processes and pollutant-Greenhouse effect. - Urban heat island-Air Act, legislation and regulations emission-Air quality management in India

Unit-2 - Sources and Effects of Air Pollution — ***9 Hour***

Sources, classification and effects-Ambient air quality and emission-Air pollution indices. - Natural Sources-Man Made Sources-Type of air pollutants standards-Effects on human health Effects on Vegetation-Ozone Layer Depletion

Unit-3 - Air Pollution Monitoring and Remedial Measures — ***9 Hour***

Smoke, smog and ozone-Sampling and meteorology-Ambient air sampling-pollution measurement methods-principles and instruments-Monitoring stations in India-temperature lapse rate and stability-diabatic lapse rate-Wind Rose, Inversion -Wind velocity and turbulence-Plume behavior-Carbon Emission-Monitoring-case studies

Unit-4 - Noise Pollution and Sources — ***9 Hour***

Noise pollution-Sources, classification-Noise act, legislation and regulations-Noise quality management in India. -Natural Sources and their classification-Manmade Sources-Remedial Measures to reduce noise pollution-Noise management in other countries

Unit-5 - Noise Pollution Monitoring Techniques — ***9 Hour***

Noise sampling and noise level meter. -CUSTIC Software-Noise Pollution Modelling-Pollution measurement methods, - Principles and instruments-Occupational noise monitoring-Infrasound, ultrasound, impulsive sound and sonic boom-Noise Indices-Noise Standards-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. Mukherjee, "Environmental Pollution and Health Hazards", causes and effects, 1986 5. Antony Milne, "Noise Pollution: Impact and Counter Measures", David & Charles PLC 1979. 6. Kenneth wark, Cecil F.Warner, "Air Pollution its Origin and Control", Harper and Row Publishers

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Elvis Dsouza, EDPC Polymer Industries, Maharashtraelvisdsouza11@gmail.com	1. Dr. Rehana Shaik, Assistant Professor, Dept of Civil Engineering, IIIT Hyderabad rehanaiisc@gmail.com	1. Mr .S. Ramesh, SRMIST
2. Dr. Rajkumar, Director Hubert Envirocare Systems, Chennai rajkumar@hecs.in.	2. Dr. E.S.M Suresh Professor & Head Department of Civil Engineering NITTTR, Chennaiesmsuresh@gmail.com	2. Mr. K. C. VinuPrakash, SRMIST

Course Code	21CEE307T	Course Name	ENVIRONMENTAL IMPACT ASSESSMENT AND LIFE CYCLE ANALYSIS	Course Category	E	PROFESSIONAL ELECTIVE	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:	learn principles and methods of environmental analysis
CLR-2:	understand how to conduct an environmental impact assessment
CLR-3:	know the interrelationship between various activities and their impact on different component of environment
CLR-4:	conduct Environmental audit, mitigation plan and risk analysis, Review and comment on an environmental impact statement
CLR-5:	explain the concept of life cycle assessment (LCA) as an environmental management tool and its potential for identifying environmental impacts from life cycle of a product

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	explain key concepts in environmental impact assessment and understand importance of various rules & regulation	3	-	-	-	-	-	3	2	-	-	-	-	3	-	-
CO-2:	identify most suitable tool for assessment process, make suggestions and role of stake holders in EIA	3	-	-	-	-	2	3	-	-	-	-	-	3	-	-
CO-3:	evaluate the Impact on various environments	3	-	-	-	-	2	3	-	-	-	-	-	3	-	-
CO-4:	participate in a group to evaluate a project using EIA using one or more management tools	3	-	-	-	-	-	3	-	-	-	2	-	3	-	-
CO-5:	explain the application of Life cycle analysis in EIA	3	-	-	-	-	2	3	-	-	-	-	-	3	-	-

Unit-1 - Introduction	**9 Hour**
Basic concepts of EIA- Screening; Scoping; Types of EIA- Overview of Environmental Laws: EPA 1986, Water Act, Forest Act; Evolution- EIA Notification1994; 2006 and EIA Draft 2020	
Unit-2 - EIA Methodologies	**9 Hour**
Baseline Description- Environmental Examination- Screening; Scoping- Methods: Checklist; Matrix; Network; Overlay; Cost Benefit Analysis- Public participation- Analysis of Alternatives- Computer tools and Software used for IEE, Screening and Scoping	
Unit-3 - Components of the Environment	**9 Hour**
Setting Baseline- Impact Prediction and Assessment of- Water, Land, Soil, Noise, Air Environment; Biota; Socio-Economic; Cultural and Aesthetics- Introduction to tools and software used for Impact Prediction and Assessment - Case Studies.	
Unit-4 - Environmental Management Plan	**9 Hour**
Environmental Management Strategies- Environmental Management Systems- ISO14001; Environmental Audit- Overview of ISO-19011; Environmental Mitigation- Risk Analysis- TOR preparation- Documentation and Report Preparation- Basic Knowledge of software used for EMP	
Unit-5 - Life Cycle Analysis	**9 Hour**
LCA and its purpose- Evolution of Life Cycle Assessment- Methodology: ISO Standard; Management- Resource Balance- Food Foot printing; Energy Balance- Energy & Carbon Foot printing & Review- Operational Control- Basic knowledge of tools and Software 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, 2ndEd., 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*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. SuyashMisra, Arcadis Consulting India Private Limited, Bangalore.*	1. *Dr. Vivekanand, Assistant Professor, MNIT, Jaipur*	1. *Dr. P. Purushothaman, SRMIST*
2. *Dr.Rajkumar, Director, Hubert Envirocare Systems, Chennai.*	2. *Dr. Harish Gupta, Assistant Professor, Osmania University, Hyderabad*	2. *Dr. K. Prasanna, SRMIST*

Course Code	21CEE308T	Course Name	PAVEMENT ANALYSIS AND DESIGN	Course Category	E	PROFESSIONAL ELECTIVE	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:	learn layered structure stress-strain analysis
CLR-2:	understand the viscoelastic characterization of the material
CLR-3:	acquire 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 and know about the pavement condition survey

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	analyze the critical conditions of the layered structure	3	3	-	-	3	-	-	-	-	-	-	-	3	-	-
CO-2:	predict the real time behavior of the material	3	2	2	2	-	-	-	-	-	-	-	-	3	-	-
CO-3:	select appropriate material for the bituminous pavement construction	3	2	2	2	-	-	-	-	-	-	-	-	3	-	-
CO-4:	design the flexible pavement for different conditions of traffic and with different material combination	3	3	3	3	3	-	-	-	-	-	-	-	3	-	-
CO-5:	evaluate the existing condition of the pavement and suggest the suitable measures to improve the condition of the pavement	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-

Unit-1 - Stress Analysis of Layered Structure — **9 Hour**

Single layer system stress analysis - Two-layer pavement stress analysis - Multilayered stress analysis - Software for Multilayered structure – distresses in the pavement – identification of stress and strain causing the distresses in the pavement

Unit-2 - Viscoelasticity — **9 Hour**

Introduction to viscoelasticity - Creep and recovery - Stress relaxation - Viscoelastic models, Voigt-Kelvin model, Maxwell model, Burger's model - Oscillatory shearing, response of elastic, viscous and viscoelastic material to oscillatory shearing.

Unit-3 - Bituminous Material — **9 Hour**

Bitumen and modified bitumen properties, viscosity and performance grades, bitumen emulsion types - Hot mix, cold mix and warm mix asphalt – Resilient modulus – Dynamic modulus – Time-temperature superposition principle – Rutting and fatigue damage characterization.

Unit-4 - Flexible Pavement — **9 Hour**

Flexible pavement design factor – Traffic factor – equivalent single wheel load , standard axle load, truck factor, vehicle damage factor, number of repetition of standard axle load - environmental factor - Design of conventional flexible and composite pavement as per IRC– determination of pavement thickness and fatigue damage analysis

Unit-5 - Evaluation of Pavement — **9 Hour**

Distress in flexible pavement - Distress of rigid pavement - Evaluation of distress, distress measurement, surface roughness, skid resistance, deflection measurements - Benkelman beam test, concept and method of measuring deflection - Falling weight deflectometer, working principle, calculation of moduli - Design of overlay by Benkelman beam method

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 Delhii* 7. *Subash C, Saxena, Textbook of Highway and Traffic Engineering, CBS Publishers, 1st Edition,2014*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com*	1. *Dr. Venkaiah Chowdary, Professor, NITW, vc@nitw.ac.in*	1. *Dr. A. Padma Rekha, SRM IST*
2. *Mr. Ankit Pachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org*	2. *Dr. V Sunitha, Associate Professor, NITT, sunitha@nitt.edu*	2. *Mr. G. Sivaprakash, SRM IST*

Course Code	21CEE309T	Course Name	RAILWAY, AIRPORT AND HARBOUR ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	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:	*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 and evaluation of the airfield pavement*
CLR-5:	*acquire knowledge on the site characteristics and component planning for harbour*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*analyze the concepts of railway alignment and design the geometric elements of railway track*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*plan and design the operational facilities for effective rail transportation*	*3*	*3*	*2*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*apply the planning and design concepts of airport components*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*design and evaluate the airfield pavement*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*evaluate the basic needs of facilities for handling the cargos in the harbour*	*3*	*2*	*2*	*2*	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Railway Planning and Design	***9 Hour***
Introduction to railway engineering - Track Alignment and the factors influencing - Engineering Surveys for Track Alignment - Permanent Way and its components, Functions of each component -Concept of Gauges, Gauges and the type of gauges - Coning of Wheels - Geometric Design of Railway Tracks, Super-Elevation, Negative superelevation, Horizontal Curves, Transition Curves, , Widening of Gauges in Curves , Gradients, Grade Compensation, Vertical Curves.	
Unit-2 - Railway Track Operation and Maintenance	***9 Hour***
Turnouts, Points and Crossings, Types and Working Principle - Signaling - Interlocking - Track Circuiting - Construction & Maintenance Materials - Track Drainage - Track Modernization - Automated maintenance and upgrading Technologies, Re-laying of Track - Lay outs of Railway Stations and Yards, Rolling Stock - Tractive Power, Track Resistance.	
Unit-3 - Airport Planning and Geometric Design	***9 Hour***
Characteristics of Air travel, Advantages and Limitations of Air Transport - Airport Master Plan, Evaluation and Institutional arrangements, Site Selection and survey, Components of airport - Runway Orientation, Cross wind Component, Wind rose Diagram - Basic Runway length and Corrections - Airport classification - Geometric design and specifications of runway - Geometric Design elements and specifications of taxiway - Runway patterns and Configurations - Minimum Separation Distances Clearance over Highways and Railways - Drainage - Airport Zoning - Aircraft parking systems	
Unit-4 - Airfield Pavement Design and Evaluation	***9 Hour***
Importance of pavement design and evaluation - Components of airfield pavement - Wheel and Axle Configurations, Traffic considerations - Stress and strain analysis in airfield pavement - Cumulative Damage Factor - Environmental factors - Design of airfield pavement. Pavement Evaluation, importance, Method of evaluation and overview - Structural Evaluation, test procedure and evaluation techniques - Functional Evaluation, test procedure and evaluation techniques	

Unit-5 - Harbour Engineering	***9 Hour***
Importance of Harbour Engineering, History and modern trends of waterway transportation, Definition of basic terms - Marine survey - Sounding - Tides and Waves, Littoral Drift - Classification of Harbours - Site Selection and harbour planning - Types of Layouts of ports and components - Approach facilities- Protection facilities, Breakwater and its types - Docking facilities, Wet docks and Dry docks - Navigational Aids, Buoys and Beacons, Light ships, Light house - Storage Facilities - Mooring facilities - Dolphins	

Learning Resources	1. *Saxena Subhash 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", Dhanpat Rai and Sons, New Delhi, 1993.* 6. *NPTEL link - https://nptel.ac.in/courses/105107123/*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 2	*Understand*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 3	*Apply*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 4	*Analyze*	*30%*	*-*	*30%*	*-*	*30%*	*-*
Level 5	*Evaluate*	*10%*	*-*	*10%*	*-*	*10%*	*-*
Level 6	*Create*	*-*	*-*	*-*	*-*	*-*	*-*
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com*	1. *Dr. Venkaiah Chowdary, Professor, NITW, vc@nitw.ac.in*	1. *Dr. A. Padma Rekha, SRM IST*
2. *Mr. Ankit Pachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org*	2. *Dr. V Sunitha, Associate Professor, NITT, sunitha@nitt.edu*	2. *Mr. G. Sivaprakash, SRM IST*

Course Code	21CEE310T	Course Name	TRAFFIC ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	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 basics of traffic flow modelling*
CLR-2:	*familiarize the microscopic models*
CLR-3:	*evaluate the level of service of traffic flow*
CLR-4:	*address the issues related to flow interruptions*
CLR-5:	*explore the facilities required for the traffic control measures*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*correlate the model parameters for the traffic stream*	*3*	*2*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*analyze the microscopic models of the traffic flow*	*3*	*2*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*perform the qualitative rankings on uninterrupted flow*	*3*	*3*	-	-	-	*2*	-	-	-	-	-	-	*3*	-	-
CO-4:	*design the facilities for the interrupted flow*	*3*	*2*	*2*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*apply the concept of traffic control measures*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Traffic Stream Modeling	***9 Hour***
Fundamental parameters of traffic stream with Time Space diagram, basic relations - Greenshield Model, Greenberg's logarithmic model, Underwood's exponential model, Moving Observer method	
Unit-2 - Microscopic Traffic Flow Modeling	***9 Hour***
Car-following modes, concept of stimulus-response, General Motor's models, numericals- Vehicle arrival models, Poisson distribution and numericals, headway modeling, random vehicle generation - microscopic traffic simulation - vehicle generation, design, calibration, validation, applications, operational models	
Unit-3 - Uninterrupted Flow	***9 Hour***
Capacity and Level of service, definitions, factors affecting LOS - HCM methods - Urban Street, Classification, Operational performance measures - Congestion management - Multilane highways, characteristics, capacity and level of service - Freeway operations, operational considerations, capacity and level of service of a basic freeway segment, weaving operation	
Unit-4 - Interrupted Flow	***9 Hour***
Traffic signs, regulatory, warning and information signs - Road markings, Longitudinal, transverse and object marking, bus bay markings - Channelization, various methods - Traffic rotary, conflict resolution, geometric layout, design elements, capacity, numericals - Grade separated intersection and its various types	
Unit-5 - Traffic Control Measures	***9 Hour***
Elements of traffic signal - Saturation flow and headway, lost time, critical flows - Design principles, phase design, cycle time determination - Webster's delay model, capacity and LOS analysis - HCM method of analysis of signalized intersection and determination of level of service - Coordinated traffic signal, offset, cycle length bandwidth - 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", Khanna Publishers, India.* 5. *Papacostas, C. S. and Prevedouros, P.D. (2001) "Transportation Engineering and Planning", Prentice Hall of India Pvt. Ltd.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com*	1. *Dr. Venkaiah Chowdary, Professor, NITW, vc@nitw.ac.in*	1. *Dr. A. Padma Rekha, SRM IST*
2. *Mr. Ankit Pachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org*	2. *Dr. V Sunitha, Associate Professor, NITT, sunitha@nitt.edu*	2. *Mr. G. Sivaprakash, SRM IST*

Course Code	21CEE311T	Course Name	PAVEMENT CONSTRUCTION TECHNOLOGY	Course Category	E	PROFESSIONAL ELECTIVE	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:	*attain knowledge about various pavement construction equipment*
CLR-2:	*comprehend the construction practices of pavement subgrade layer*
CLR-3:	*explore the construction practices of different layers of flexible pavement*
CLR-4:	*explore the construction practices of different layers of rigid pavement*
CLR-5:	*know the highway drainage system design and understand the construction practices*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*plan and select the suitable equipment for the construction of highway*	*3*	*3*	-	-	-	-	-	*2*	-	-	-	-	*3*	-	-
CO-2:	*discriminate construction practices in subgrade layer*	*3*	*3*	-	-	-	-	-	*2*	-	-	-	-	*3*	-	-
CO-3:	*demonstrate the construction of flexible pavement layers*	*2*	*3*	-	-	-	-	-	*2*	-	-	-	-	*3*	-	-
CO-4:	*demonstrate the construction of rigid pavement layers*	*3*	*3*	-	-	-	-	-	*2*	-	-	-	-	*3*	-	-
CO-5:	*apply the design techniques for the construction of drainage systems*	*3*	*3*	-	-	-	-	-	*2*	-	-	-	-	*3*	-	-

Unit-1 - Pavement Construction Equipment	***9 Hour***
Equipment for excavation, grading and compaction, their working principle, advantages and limitations – Bituminous mixture mixing plant - Special equipments for bituminous road construction - Special equipments for cement concrete pavement construction.	
Unit-2 - Subgrade Construction	***9 Hour***
Earthwork grading, principles of gradation/proportioning of soil-aggregate mixes and compaction - Compaction and construction of embankments and cuts, embankment construction on weak and compressible foundation - Quality control tests - Design factors, mix design, construction control and quality control checks for soil-cement, soil-bitumen and soil-lime stabilization methods	
Unit-3 - Flexible Pavement Layers Construction	***9 Hour***
Methods of construction and field control checks for various layers of flexible pavement in sub-base, base, binder and surface course - Need for recycling, methods of recycling, construction controls - Warm mix and cold mix asphalt pavement layer construction	
Unit-4 - Rigid Pavement Construction	***9 Hour***
Concrete mix design procedure - Methods and guideline for construction for concrete pavement - Construction of supporting layers of CC pavement, pavement slab, joints in pavements and its quality control check during construction - Construction practice of brick, stone and concrete block pavement	
Unit-5 - Special Construction Practices	***9 Hour***
General guidelines for construction of pavement in water logged areas as per IRC specifications - Design and construction of surface and sub-surface drainage system - Functions and applications of Geosynthetics in highway embankment - new pavements and overlay construction – Construction practices of bridges	

Learning Resources	1. *S. K. Khanna, C.E.G. Justo and A. Veeraragavan, "Highway Engineering", Revised 10th edition, Nem Chand &Bros., Roorkee, 2014.* 2. *Sharma, S.C."Construction Equipment and its Management"- Khanna Publisher* 3. *Freddy L. Roberts, Prithvi S. Khandal, E. Ray Brown, Dah-Yinn Lee and Thomas W. Kenneday, Hot Mix Asphalt Materials, Mixture, Design and Construction, NAPA Education Foundation, 1997*	4. *Norbert J. Delatte, 'Concrete Pavement Design, Construction and Performance', Second Edition, CRC Press, 2014* 5. *Peurify.R.L. "Construction Planning, Equipment and Methods", McGraw Hill Publishers, New York, 2000.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com*	1. *Dr. Venkaiah Chowdary, Professor, NITW, vc@nitw.ac.in*	1. *Dr. A. Padma Rekha, SRM IST*
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Course Code	21CEE312T	Course Name	COMPUTER APPLICATION IN HIGHWAY ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	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 and practice the concepts in the geometric design of highway and simulate the horizontal and vertical alignment of highway*
CLR-2:	*simulate the traffic condition and study the traffic conflict points*
CLR-3:	*know the layered analysis of the structure with all the design constrains*
CLR-4:	*understand the influence of nonlinearity and the viscoelastic effect the stress/strain analysis*
CLR-5:	*understand the components of rigid pavement and its design*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*design the geometric cross-section of highway and design the horizontal and vertical alignment of highway*	*3*	*2*	*3*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*
CO-2:	*design the road sections to reduce traffic conflict points*	*3*	*2*	*3*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*
CO-3:	*analyze the layered structure in the flexible pavement and design the pavement for critical conditions*	*3*	*2*	*3*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*
CO-4:	*apply the concept of nonlinearity and viscoelasticity in the analysis of pavement*	*3*	*2*	*3*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*
CO-5:	*analyze the layered structure in the rigid pavement and design the pavement for critical conditions*	*3*	*2*	*3*	*3*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*-*

Unit-1 - Highway Geometry, Horizontal and Vertical Alignment	***9 Hour***
Terrain classification - Introduction to the features of road geometric design software, Terrain input from various source - Terrain analysis - Carriageway design and Horizontal alignment and superelevation design - highways corridors - Profiles and cross-sections - Vertical profiling - Earth work calculation – Calculation of cut and fill – Surface analysis of highway	
Unit-2 - Traffic Flow Characteristic Study	***9 Hour***
Traffic flow simulation techniques - Simulation of traffic stream - Analysis of travel behavior - Traffic control measures - Signal Design - Design parameters and standards - Developing intersection for any given study area - Analysis of the flow parameters in the intersection for signal design - Traffic control measures - Rotary design - Design parameters and standards - Creation of layout of a rotary at an intersection - Analysis of the traffic flow in the rotary and Evaluation of rotary capacity.	
Unit-3 - Analysis of Flexible Pavement	***9 Hour***
Linear elastic layered analysis Stress analysis of multi layered structure – Critical stress and critical location in the layered structure - Structural Input and calculation of stress and strain - Analysis of critical stress/strain at various locations - Pavement design – traffic, material and climatic conditions - Traffic, material and climate input for the ME pavement design - Design of bituminous concrete pavement with unbounded and bonded layers	
Unit-4 - Nonlinear and Viscoelastic Analysis of Flexible Pavement	***9 Hour***
Nonlinear models – layered analysis – Introduction to linear viscoelasticity – Linear Viscoelastic models – Pavement layer analysis with the material exhibiting nonlinear behavior and viscoelastic behavior.	
Unit-5 - Design of Rigid Pavement	***9 Hour***
Component of Rigid pavement and Layer inputs - Design basics – Thermal stress and stress due to wheel load - Structural Input and calculation of stress and strain (Rigid pavement) – Design of joints - Dowel bar analysis and design	

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 10thedition, Nem Chand &Bros., Roorkee, 2014.* 3. *Roess, R. P. McShane, W. R. & Prassas, E. S. (1998), Traffic Engineering, Prentice – Hall.*	4. *Yang Huang, Pavement Analysis and Design, Pearson, 2004* 5. *Yoder,E.J., and Witczak, Principles of Pavement Design, 2nd ed.John Wiley and Sons, 1975.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*20%*	-	*20%*	-	*20%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	*10%*	-	*10%*	-	*10%*	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. Asif Ahmed, Business manager, Ingevity, ahmed.asif@ingevity.com*	1. *Dr. Venkaiah Chowdary, Professor, NITW, vc@nitw.ac.in*	1. *Dr. A. Padma Rekha, SRM IST*
2. *Mr. Ankit Pachouri, Transport Planner, IUT, New Delhi, ankit.pachouri@iutundia.org*	2. *Dr. V Sunitha, Associate Professor, NITT, sunitha@nitt.edu*	2. *Mr. G. Sivaprakash, SRM IST*

Course Code	21CEE401T	Course Name	ADVANCED PRESTRESSED CONCRETE	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:	*introduce the concepts of prestress concrete and to analyse prestress concrete sections*
CLR-2:	*explore short- and long-term deflections and transfer of prestressing by bond*
CLR-3:	*understand about composite section under flexure and shear*
CLR-4:	*know about the process of design of pipes, piles and pavements*
CLR-5:	*study folded plates, shell and continuous beam*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*analyze the prestress concrete sections using different concepts*	*3*	*3*	*3*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*determine short- and long-term deflections and bond stress in prestressed concrete members*	*3*	*3*	*3*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*evaluate the flexural and shear strength of prestressed composite section*	*3*	*3*	*3*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*design the cylinder and non-cylinder pipe, piles and pavements*	*3*	*3*	*3*	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*demonstrate the design of folded plates and shell and continuous beam*	*3*	*3*	*3*	*2*	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Introduction to Prestressed Concrete	***9 Hour***
Prestressed concrete Introduction - basic concept –principle of prestressing – materials, Forms of steel – systems of prestressing Types of prestressing – uses ofprestressed concrete. Materials – concrete strength limitation – requirements of steel for prestressed concrete. Analysis – basic assumptions Stress and Stress concept, Load balancing concept – cable profile – reaction – equivalent loads	
Unit-2 - Deflections in Prestressed Concrete	***9 Hour***
Deflections-Reasons to control deflections – factors influencing deflections – short term deflection – uncracked section - Mohr's theorems, Deflection due to different cable profiles, Prediction of long-term deflections, Bond Transmission of prestressing force - transmission length.	
Unit-3 - Composite Construction	***9 Hour***
Composite construction Introduction – composite action - advantages – types of composite construction, Methods of construction – propped –unpropped construction, Analysis of stresses, Flexural strength of composite section, Shear strength of composite section	
Unit-4 - Prestressed Pipes and Pavements	***9 Hour***
Design of pipes, Design of non-cylinder pipes –losses of prestress- Design of cylinder pipes Design of shear reinforcement Design of piles Advantages – driving stresses –service load stresses reinforcements, Design of pavements general features – design of prestress in pavements.	
Unit-5 - Analysis of Statically Determinate Plane Trusses	***9 Hour***
Introduction - types of folded plates – slab action – plate action – names of methods for analysis, Shell Introduction –advantages –methods of prestressing – design. Continuous beams Advantages – effects of prestressing - primary moment – secondary moment – resultant moment –pressure line- Use of theorem of three moments – examples-Concordant Cable Profiles	

Learning Resources	1. *Krishnaraju. R, "Prestressed Concrete", Tata McGraw-Hill Education, Edition: 2018, NewDelhi.* 2. *Pandit. G.S, Gupta. S.P, "Prestressed Concrete", CBS Publishers & Distributors, 2008* 3. *S. Ramamrutham, "Prestressed Concrete", Dhanpat Rai Publishing Company, Fifth Edition, Reprint 2016*	4. *Lin T.Y, Design of, "Prestressed Concrete Structures", Asia Publishing House, Bombay 1995.* 5. *IS: 1343-2012 "IS Code of Practice for Prestressed Concrete", BIS, New Delhi, 2012.* 6. *NPTEL Course: Prestressed Concrete Structures: https://nptel.ac.in/courses/105106117/*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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 RulalDepartment, NITTTR*	1. *Dr. P.R.Kannan Rajkumar, 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*	2. *Dr. C.Sudha,SRMIST*

Course Code	21CEE402T	Course Name	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES	Course Category	E	PROFESSIONAL ELECTIVE	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 fundamentals of earthquake and its characteristics*
CLR-2:	*understand the principles of structural dynamics with regard to Single Degree of Freedom (SDOF) system*
CLR-3:	*multi Degree of Freedom System (MDOF) with structural systems and seismic weight calculation and analysis*
CLR-4:	*apply structural dynamics principles to the analysis of structures, Design members and frames with emphasis on ductile detailing*
CLR-5:	*understand the Modern concepts in Assessment and Retrofitting techniques*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*apply the acquired knowledge on idealizing the structures and on applying loading*	*3*	-	-	-	-	-	*3*	*2*	-	-	-	*2*	*3*	-	-
CO-2:	*analyze single degree moment resistant frame for free and forced vibrations*	*3*	*3*	-	*2*	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*analyze two-degree moment resistant frame for free vibrations using modal superposition method and calculate base shear using equivalent static method as per IS 1893 (Part1): 2016*	*3*	*3*	*3*	*2*	-	-	-	*2*	-	-	-	-	*3*	-	-
CO-4:	*calculate base shear using response spectrum method as per IS 1893 and apply the provisions of IS13920 in detailing*	*3*	*3*	*3*	*2*	-	*3*	-	*2*	-	-	-	-	*3*	-	-
CO-5:	*able to suggest assessing techniques and retrofitting techniques for structures*	*3*	-	*3*	-	*3*	*3*	*2*	*2*	-	-	-	*2*	*3*	-	-

Unit-1 - Introduction to Earthquake Engineering	***9 Hour***
Earthquake – Introduction, Seismic Waves, Faults, Magnitude and Intensity - Ground Motions– Seismic effects on structures – Lessons learned from Past earthquake on architectural features, Seismic design philosophy – Idealization of structures –Types of Loading, Characteristics of Dynamic Load - Discretization.	
Unit-2 - SDOF – Single Degree of Freedom Systems	***9 Hour***
Single Degree of freedom (SDOF) systems – Introduction - Equation of motions - Free and Forced vibrations – Undamped and Damped Systems – Logarithmic Decrements – Resonance- Problems, Vibration Measuring Instruments	
Unit-3 - Multiple Degree of Freedom Systems and Design Seismic Forces	***9 Hour***
Introduction to Systems with two degrees and Three degree of freedom – Computation of Stiffness and mass matrix – Modal Super position method – Mode shape, Structural systems – Lateral Load Resisting systems Seismic Load calculations, Design seismic forces by Equivalent lateral force method as per IS1893 (Part 1) : 2016	
Unit-4 - Dynamic Analysis and Ductile Detailing	***9 Hour***
Dynamic Analysis – Determination of Displacement and Drift as per IS1893 (Part 1):2016. Ductile detailing requirements of Beam, Column, frame and shear wall as per IS 13920: 2016	
Unit-5 - Damage Assessment and Seismic Retrofitting	***9 Hour***
Damage Assessment – Procedure – Nondestructive Testing, Retrofitting – Local – Global – Concrete and Masonry Buildings, Structural Control Systems – Passive control – Active Control- Disaster management	

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. *Pankaj Agarwal and Manish shrikhande, "Earthquake resistant design of structures", PHI Learning Pvt. Ltd., 2006.*	4. *IS 1893 (Part I): 2016, "Criteria for Earthquake Resistant Design of Structures - Part 1: General Provisions and Buildings", BIS, 2016.* 5. *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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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 Rural Department, NITTTR*	1. *Dr. S. Senthil Selvan, 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*	2. *Mr. S. Pradeep, SRMIST*

Course Code	21CEE403T	Course Name	DESIGN OF STEEL-CONCRETE COMPOSITE STRUCTURES	Course Category	E	PROFESSIONAL ELECTIVE	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:	explain the concept of steel-concrete composite member design and to get introduced to the relevant IS codes
CLR-2:	know the concepts in performing design of steel-concrete composite beams and slabs
CLR-3:	study the concepts in performing design of steel-concrete composite columns
CLR-4:	explore the concepts in performing design of steel-concrete composite connections
CLR-5:	understand the long-term effects on steel-concrete composite design

Course Outcomes (CO):	At the end of this course, learners will be able to:	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-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	3	2	2	2	-	-	-	-	-	-	-	3	3	-	-
CO-2:	analyze the behavior of steel-concrete composite sections under flexure and shear	3	3	3	3	-	-	-	-	-	-	-	3	3	-	-
CO-3:	utilize the limit state method of design for steel-concrete composite columns	3	3	3	3	-	-	-	-	-	-	-	3	3	-	-
CO-4:	apply limit state method of design to steel-concrete composite connections	3	3	3	3	-	-	-	-	-	-	-	3	3	-	-
CO-5:	analyze the behavior of steel-concrete composite sections under long-term effects	3	3	3	3	-	-	-	-	-	-	-	3	3	-	-

Unit-1 - Introduction	**9 Hour**
Introduction to Steel-Concrete composite construction-Mechanism of composite action-Materials to be used-Structural advantages- Limitations-Factors deciding selection of materials-Introduction to Steel-Concrete composite codes/standards- Limit states of Steel- Concrete composite sections-Shear Connectors-Types-Degree of shear connection-Strength of shear connectors	
Unit-2 - Design of Steel- Concrete Composite Beams and Slabs	**9 Hour**
Behaviour of composite beams and slabs- Design of composite beams without profile sheet-un-propped and propped condition-Choice of cross-sections-Profile Sheeting-Introduction to Composite floor system	
Unit-3 - Design of Steel-Concrete Composite Columns	**9 Hour**
Introduction- Types of composite columns- Choice of cross-sections-Behaviour of composite columns-Design- P-M Interaction curve	
Unit-4 - Design of Connections	**9 Hour**
Introduction- Types of connections- Choice of connections in composite structures- Behaviour- Basic concepts- Design procedure	
Unit-5 - Long–Term Effects	**9 Hour**
Effect of creep and shrinkage of concrete on composite design and construction-Introduction to Seismic behaviour of Steel-Concrete composite structure	

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.	3. Johnson.R.P, "Composite Structures of Steel and Concrete". Vol-I, # Oxford Black; well Scientific Publications (Third Edition) U.K. 2004.
2. Owens. G.W, & Knowels.P. "Steel Designs Manual", (sixth Edition) Steel Concrete Institute (UK) Oxford Black; well Scientific Publications, 2003	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

Learning Assessment							
	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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. *.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*	2. *Prof. N.Umamaheswari, SRMIST*

Course Code	21CEE404T	Course Name	SURFACE HYDROLOGY	Course Category	E	PROFESSIONAL ELECTIVE	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:	*create insights into analysis and interpretation of precipitation data*
CLR-2:	*address concepts related to water losses*
CLR-3:	*explore the concepts of runoff and hydrograph analysis*
CLR-4:	*comprehend flood estimation and to explore reservoir routing and stream flow routing*
CLR-5:	*know various types of models and their processes*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*analyze and interpret precipitation data*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*analyze various water losses*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*solve runoff estimation and hydrograph analysis*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*illustrate flood estimation and analyze reservoir and stream flow routing*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*distinguish various models and their processes*	*3*	-	-	-	*3*	-	-	-	-	-	-	*3*	*3*	-	-

Unit-1 - Precipitation	***9 Hour***
Hydrologic cycle – Global distribution of water – Water resources of India – Weather & Climate - Seasons in India – Distribution of rainfall in India – Precipitation – Radar measurement of rainfall – Analysis of rainfall data - Test for consistency – Mass curve – Hyetograph – DAD curve – IDF curves – Frequency analysis - Hydrologic equation – Water budget	
Unit-2 - Water Losses	***9 Hour***
Evaporation – Dalton's law – Evaporation pans – Transpiration – Evapotranspiration - Blaney-Criddle method – Infiltration – Horton's equation – Infiltrometer – Phi index and W-index	
Unit-3 - Runoff	***9 Hour***
Components of stream flow – Catchment characteristics – Classification of streams – Factors affecting runoff – Runoff estimation – Hydrograph components – Baseflow separation – Unit hydrograph – S-curve – Synthetic unit hydrograph – Snyder's method	
Unit-4 - Floods & Flood Routing	***9 Hour***
Floods – Types – Rational method – Empirical formulae – Flood frequency studies - California method and Weibull method - Encounter probability: Probability of exceedance and Probability of non-exceedance – Flood routing – Reservoir routing – ISD method & Modified Pul's method – Stream flow routing – Prism storage & Wedge storage - Muskingum method – Flood forecasting and warning.	
Unit-5 - Systems & Models	***9 Hour***
System concept in hydrology – Types of models – Watershed – System concept – Types of watershed models – Artificial Neural Network - Network training algorithm – Back propagation- Advantages and limitations of ANN - Fuzzy sets and fuzzy logic - Fuzzification, evaluation of rules, defuzzification - Fuzzy rule based reservoir operation model	

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. *Chow, V.T., and Maidment, Hydrology for Engineers, McGraw Hill Inc., Ltd., 2000*	4. *Jaya Rami Reddy, A textbook of Hydrology, University Science Press, 2013* 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. *NPTEL course – Watershed Management: https://nptel.ac.in/courses/105101010/16*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 2	*Understand*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 3	*Apply*	*30%*	*-*	*30%*	*-*	*30%*	*-*
Level 4	*Analyze*	*30%*	*-*	*30%*	*-*	*30%*	*-*
Level 5	*Evaluate*	*-*	*-*	*-*	*-*	*-*	*-*
Level 6	*Create*	*-*	*-*	*-*	*-*	*-*	*-*
	Total	*100 %*		*100 %*		*100 %*	

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. Shaik Niyazuddin Guntakal, SRMIST*

Course Code	21CEE405T	Course Name	GROUNDWATER ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	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:	*create insights into the occurrence and properties of groundwater*
CLR-2:	*address concepts related to movement of groundwater*
CLR-3:	*know well hydraulics*
CLR-4:	*comprehend concepts related to exploration and investigation of groundwater*
CLR-5:	*explore groundwater quality, management and modelling*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*identify the various properties of groundwater*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*apply and analyze the governing equations of groundwater movement*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*recognize yield of the well and its hydraulics*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*illustrate the various methods of investigation and exploration of groundwater*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*understand the concept of groundwater quality, management and modelling*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Introduction to Groundwater	***9 Hour***
Ground water resources – Ground water recharge – Ground water development in India – Various water bearing formations – Types of Aquifers – Aquifer properties – Groundwater fluctuation – Groundwater balance and budgeting – GEC norms - Groundwater potential in India	
Unit-2 - Groundwater Movement	***9 Hour***
Groundwater Movement- Governing Equation - Darcy's Law - Heterogeneity and anisotropy - Estimation of aquifer parameters - 1D & 2D governing equation of flow through porous medium - Equation for flow into leaky aquifer - Flow through unconfined aquifer- Boundary conditions - Groundwater flow rates and direction - Aquifer with recharge - Flow into confined aquifer with constant and variable thickness	
Unit-3 - Well Hydraulics	***9 Hour***
Flow into well – Steady radial flow: Dupuit's and Theim's equations – Unsteady radial flow: Theis & Jacob equations – Wells in leaky aquifer – Partially penetrating wells – Image well theory – Multiple wells – Well capacity & Well development – Construction and types of open & tube wells – Pumping test & Recuperation test	
Unit-4 - Subsurface Exploration	***9 Hour***
Objective and Need for exploration - Geophysical investigations - Surface geophysical techniques - Electrical resistivity method - Seismic refraction method - Remote sensing in groundwater exploration - Other surveying methods - Borehole geophysical techniques, Electric logging, radioactive logging, Induction, fluid and sonic logging - Geochemical method of exploration - Application of GIS in groundwater exploration - Seawater intrusion theory - Causes and effects of seawater intrusion - Various methods of reducing seawater intrusion	
Unit-5 - Groundwater Management and Modeling	***9 Hour***
Groundwater quality standards - Types and sources of groundwater contamination - Various quality parameters and its significance - Attenuation of groundwater quality- Potential evaluation of groundwater quality - Physical, chemical and biological method of analysis - Conjunctive use of groundwater and basin management - Groundwater development under various scales - Groundwater modeling, problems in groundwater - Types of models - Conceptual model, physical model, Mathematical model and analog model - Data, input, boundary conditions and output, prediction - Calibration and validation of a model - Groundwater models	

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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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. Shaik Niyazuddin Guntakal, SRMIST*

Course Code	21CEE406T	Course Name	DESIGN OF HYDRAULIC STRUCTURES AND IRRIGATION ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	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 diversion headworks and distribution systems*
CLR-2:	*explore cross drainage works and their design*
CLR-3:	*know different types of dams and their design particulars*
CLR-4:	*provide an understanding of canal structures*
CLR-5:	*address mechanics of sediment transport and explore the design of stable and lined canals*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1 Engineering Knowledge	2 Problem Analysis	3 Design/development of solutions	4 Conduct investigations of complex problems	5 Modern Tool Usage	6 The engineer and society	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*illustrate different components of diversion headworks and distribution systems*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*distinguish different cross drainage works*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*design gravity and earthern dam*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*identify and design various canal structures*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*illustrate sediment transport and design stable and lined canals*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Diversion Headworks and Distribution Systems	***9 Hour***
Diversion head works- Layout and functions - Weir and barrage- Causes of failure of weirs on permeable soils - Bligh's theory - Design of vertical drop weir - Khosla's theory of independent variables- Khosla's corrections -Use of Khosla's charts - Irrigation canals - Canal alignment - Cross section of unlined canals - Design of canals through alluvial soils - Kennedy's theory and Lacey's theory	
Unit-2 - Cross Drainage Works	***9 Hour***
Cross drainage works - Types - Selection of suitable type - Design of Aqueduct (Type III) – Design of Syphon Aqueduct (Type III)	
Unit-3 - Dams	***9 Hour***
Dams -Types - Gravity dam – Selection of site - Stability analysis and modes of failure – Elementary profile – Design of gravity dam - Types of galleries – Earth dams – Types - Causes for failure and design criteria - Spillways – Types and design consideration	
Unit-4 - Canal Structures	***9 Hour***
Canal regulators – Head and cross regulator - Functions – Alignment of off-taking channel - Design of cross regulator - Design of distributary head regulator - Canal falls – Necessity and location of falls - Types of canal falls - Design of a trapezoidal notch fall - Design of simple vertical drop fall - Design of a Sarda fall – Canal Escape	
Unit-5 - Conveyance	***9 Hour***
Mechanics of sediment transport – Design capacity of irrigation canal - Shield's entrainment method - Design of non-scouring stable channels with protected side slopes in alluvium soil - Design of most efficient channel section - Design of stable channels – Kennedy's theory - Design of stable channels – Lacey's theory - Balancing depth of canals - Economic justification of canal lining for unlined canals - 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. *Asawa G. L., "Irrigation and Water Resources Engineering", New Age International Publishers, New Delhi, 2005*	4. *Sharma R.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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

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. Shaik Niyazuddin Guntakal, SRMIST*

Course Code	21CEE407T	Course Name	ADVANCE HYDRAULIC ENGINEERING AND DESIGN	Course Category	E	PROFESSIONAL ELECTIVE	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:	*study dimensional and model analysis*
CLR-2:	*address concepts on boundary layer theory*
CLR-3:	*explore measuring discharge and velocity in open channels*
CLR-4:	*know the concepts related to uniform flow in open channel*
CLR-5:	*understand the concepts related to non-uniform flow in open channel*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*solve various fluid problems involving dimensional and model analysis*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*appraise the concepts of boundary layer theory*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*estimate discharge and velocity in open channels*	*3*	*3*	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*analyze uniform flow in open channels*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*illustrate non-uniform flow in open channels*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	*3*	-	-

Unit-1 - Dimensional and Model Analysis	***9 Hour***
Use of dimensional analysis - Fundamental and derived quantities - MLT system - Dimensional homogeneity - Rayleigh's method - Buckingham Pi method - Application of dimensional analysis - Model analysis - Similitude - Geometric similarity- Kinematic and dynamic similarity - Dimensionless numbers and their significance - Model laws - Model studies in fluid flow problems	
Unit-2 - Boundary Layer Theory	***9 Hour***
Boundary layer definitions and characteristics - Boundary layer thickness - Displacement thickness - Momentum and Energy thickness - Flow around submersible bodies - Forces exerted by flowing fluid on the body - Expression for Drag and Lift – Dimensional analysis of drag and Lift	
Unit-3 - Velocity and Flow Measurement	***9 Hour***
Non-Modular flume or Venturi flume - Modular flume or the Standing wave flume - Stream Flow measurements - Direct method of stream discharge - Indirect Method of stream discharge - Measurement of velocity - Current meter- Floats - Area -Velocity Method.	
Unit-4 - Uniform Flow Through Open Channel	***9 Hour***
Comparison between open channel and pipe flows - Types of channels and types of flow in channels - Chezy's formula - Manning's formula - Design of most economical section - Rectangular and trapezoidal channel.	
Unit-5 - Non-Uniform Flow Through Open Channels	***9 Hour***
Specific energy and specific energy curve, Critical depth, critical velocity, Minimum specific energy, critical flow; Subcritical flow and supercritical flow, gradually varied flow, Characteristics of surface profiles, curve and afflux, Length of back water curve and afflux, rapidly varied flow, hydraulic jump and its types, Expression for loss of energy due to jump, length of hydraulic jump, height of jump, Energy dissipaters and Length of back water stilling basins.	

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. K. Subramanya; Engineering hydrology; McGraw Hill, fourth edition 6. Chandramouli P.N., Applied Hydraulic Engineering, Yesdee, 2017 7. NPTEL Course-Hydraulics. https://nptel.ac.in/courses/105106114/# 8. NPTEL Course-Fluid Machinery. https://nptel.ac.in/courses/112104117/

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

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. Mrs. D. Jaishree, SRMIST

Course Code	21CEE408T	Course Name	FUNDAMENTALS OF REMOTE SENSING AND GIS	Course Category	E	PROFESSIONAL ELECTIVE	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:	*studying the basic principles of remote sensing*
CLR-2:	*studying and understanding various remote sensing methods*
CLR-3:	*understanding GIS and data capturing*
CLR-4:	*studying data analysis in GIS*
CLR-5:	*application of RS and GIS in various fields*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*study the basic principles of remote sensing*	*3*	-	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	-
CO-2:	*study and understand various remote sensing methods*	*3*	-	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	-
CO-3:	*understand GIS and components*	*3*	-	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	-
CO-4:	*study the data capturing and data analysis in GIS*	*3*	-	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	-
CO-5:	*apply RS and GIS in various field*	*3*	-	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	-

Unit-1 - Basics of Remote Sensing	***9 Hour***
Definition, Concept and Components of Remote Sensing, EMR, Importance of EM Energy, EMR Interaction with Atmosphere and Earth surface, Limitation of Remote Sensing, Remote Sensing Process, Wave Theory Active and Passive Remote Sensing	
Unit-2 - Sensors	***9 Hour***
Types of Remote Sensing, Platform, Satellite Characteristics, orbit and swaths, Sensor System, Resolutions, Weather satellites, GOES, Landsat, IRS, High Resolution satellites-IKNOS, Passive Satellites-Hyperspectral Sensors, Microwave Sensors, Radar –RAR, SAR and SLAR	
Unit-3 - Fundamentals of GIS	***9 Hour***
Definition, History, Requirements of GIS, GIS Integration-Remote Sensing, Cartography and Mapping, GPS, Comp., RDBMS, Need and Scope and importance of GIS. Components of GIS- Hardware, Software, Data, Method, People, GIS Data and Data Types-Spatial and Non-spatial Data, Vector and Raster data, Various types of Map Analysis	
Unit-4 - Data Input and Output	***9 Hour***
Master data Input-Scanner & types, Image Input, Vector data Input-Digitization-Manual and Automatic. Topology, Attribute data, Vector data Analysis, Raster data Analysis. DEM	
Unit-5 - : Applications of RS and GIS	***9 Hour***
Importance of RS and GIS, Applications of Remote Sensing - Land, Ocean and Atmosphere, Agriculture, Forests, Geology, Hydrology, Sea Ice. Applications of GIS Applications – Natural Resource Management Engineering, Navigation, Vehicle Tracking, Marketing and business Applications	

Learning Resources	1. George Joseph and C Jeganath, Fundamentals of remote Sensing, University Press, Third Edition,2018 2. M. Anji Reddy, Textbook of Remote Sensing and Geographical Information systems, BS Publications 3. A.M. Chandra and S.K. Ghosh. Remote Sensing and Geographical Information system. Narosa Publishing, House, New Delhi. 2006	4. Thomas M. Lillesand, Ralph W. Kiefer, Jonathan W. Chipman, "Remote Sensing and Image Interpretation", John Wiley & Sons, 2008. 5. NPTEL Course — Introduction to GIS https://nptel.ac.in/courses/105102015/ 6. NPTEL Course, Introduction to remote sensing, https://nptel.ac.in/courses/105108077/

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (CLA)				Summative Final Examination (40% weightage)	
		Formative CLA-1 Average of unit test (50%)		Life-Long Learning CLA-2 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	20%	-	20%	-
Level 2	Understand	20%	-	20%	-	20%	-
Level 3	Apply	30%	-	30%	-	30%	-
Level 4	Analyze	30%	-	30%	-	30%	-
Level 5	Evaluate	-	-	-	-	-	-
Level 6	Create	-	-	-	-	-	-
	Total	100 %		100 %		100 %	

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	1. Dr. R. Nagendra, Anna University, geonag@gmail.com	1. Dr. R Annadurai, SRMIST
2. Mr.G.Hariharanath, Chief Executive ,GA consultants,gac1996@hotmail.com	2. Dr. Nisha Radha Krishnan, NIT Trichy	2. Dr. Sachikanta Nanda, SRMIST

Course Code	21CEE409T	Course Name	GIS AND ITS TECHNIQUES	Course Category	E	PROFESSIONAL ELECTIVE	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 about GIS*
CLR-2:	*know the data formats and Quality*
CLR-3:	*learn the data models for storing data*
CLR-4:	*analyze the spatial data analysis*
CLR-5:	*analyse advanced techniques with case study*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*relate the concepts of GIS*	*3*	-	-	-	*2*	-	*3*	-	-	-	-	-	*3*	*3*	-
CO-2:	*recognize the data format and standards*	*3*	-	-	-	*2*	-	*3*	-	-	-	-	-	*3*	*3*	-
CO-3:	*interpret the data models*	*3*	-	-	-	*2*	-	*3*	-	-	-	-	-	*3*	*3*	-
CO-4:	*apply the spatial analysis for real problems*	*3*	-	-	-	*3*	-	*3*	-	-	-	-	-	*3*	*3*	-
CO-5:	*evaluate the role of GIS in real world problems*	*3*	-	-	-	*3*	-	*3*	-	-	-	-	-	*3*	*3*	-

Unit-1 - Introduction to GIS	***9 Hour***
GIS definition, components, Functionalities, Coordinate system, Datum, Projection, Maps – types, Cartography – generalization – symbolization, lay out, Spatial – non-spatial data	
Unit-2 - Data Representation and Data Quality	***9 Hour***
Vector data and raster data format, Data Quality, Topology, Data Sources, Input methods, Data Accuracy, data standards, Vector data model – Georelational model – coverage data model – shape file – TIN	
Unit-3 - Data Structure	***9 Hour***
Raster data model - Elements, Raster data structure – Run length encoding, Cell by cell encoding – Block Encoding – QuadTree, DEM – Types, Sources- DTM - DSM	
Unit-4 - Spatial Data Analysis	***9 Hour***
Terrain Analysis – Slope – Aspect – Shaded relief maps - Contour, Viewshed analysis, Query – Types- spatial query – attribute query, Buffering, Vector Overlay Operations- point on polygon, line on polygon, polygon on polygon, Raster Overlay	
Unit-5 - Advanced Techniques and Case Study	***9 Hour***
Reclassification, Measurements - vector and raster, Interpolation – Local – Global, Spatial Models – Cartographic models – Spatio-temporal models - Cell based Models, Multi-Criteria analysis case study, Site suitability case study, Change detection study	

Learning Resources	1. *Paul Bolstad," GIS Fundamentals: A First Text on Geographic Information Systems" 5th Edition, Eider Press, Minnesota 2016.* 2. *Burrogh. P.A, "Principles of Geographical Information System for Land Resources Assessment", Oxford Publications, | ISBN-13: 978-0198545927, 1986.* 3. *Kang Tsung Chang, "Introduction to Geographical Information System", Tata McGraw Hill, 9th edition, 2019.*	4. *Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, "Geographic Information Science & Systems", Fourth Edition, John Wiley & Sons, Inc.,2015.* 5. *Chandra. A. M. and Ghosh S. K, "Remote Sensing and GIS", Narosa Publishing House, New Delhi, 2000.* 6. *Michael N. DeMers, "Fundamentals of Geographic Information Systems", 2008.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. Tune Usha, Scientist, NCCR, Chennai*	1. *Dr. S. Sanjeevi, Professor, Anna University, Chennai*	1. *Dr. Aparna S Bhaskar, SRMIST*
2. *Dr. Sarunjith K J, Scientist, NCSCM*	2. *Dr. V. J Rajesh, Associate Professor, IIST, Thiruvananthapuram*	2. *Dr. Sachikanta Nanda, SRMIST*

Course Code	21CEE410T	Course Name	CONSTRUCTION EQUIPMENT AND AUTOMATION	Course Category	E	PROFESSIONAL ELECTIVE	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:	*identify the management concepts of construction equipment*
CLR-2:	*identify the various earthwork equipment and its applications in real projects*
CLR-3:	*identify the various off shore equipment and techniques for dewatering*
CLR-4:	*apply the knowledge in demolition and dismantling the distressed structures*
CLR-5:	*accrue comprehensive knowledge of automation in construction practices*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*apply the acquired knowledge on building materials and products for construction*	*3*	*2*	*-*	*1*	*-*	*-*	*-*	*2*	*2*	*2*	*3*	*3*	*3*	*-*	*-*
CO-2:	*identify various building finishing materials and ferro cement applications for the building construction*	*3*	*3*	*-*	*1*	*1*	*-*	*-*	*-*	*3*	*3*	*3*	*2*	*3*	*-*	*-*
CO-3:	*apply the knowledge on the masonry, building transport and the termite treatment*	*3*	*3*	*-*	*2*	*2*	*-*	*-*	*-*	*3*	*3*	*3*	*2*	*3*	*-*	*-*
CO-4:	*disseminate the knowledge on various ecofriendly building materials*	*3*	*3*	*-*	*3*	*2*	*-*	*-*	*-*	*3*	*3*	*3*	*2*	*3*	*-*	*-*
CO-5:	*recognize the energy efficient buildings and cost-effective construction techniques*	*3*	*3*	*-*	*2*	*3*	*-*	*3*	*-*	*3*	*3*	*3*	*3*	*3*	*-*	*-*

Unit-1 - Construction Equipment Management	***9 Hour***
Introduction on Construction Equipment - Equipment Management in Construction Projects- Management Programme- Maintenance and Safety management Equipment requirement for construction project- Downtime- Calculation Planning of Equipment- Selection of Equipment- Cost Control of Equipment -Depreciation on Equipment- Methods to calculate depreciation- Conventional construction methods - Advanced Mechanized methods- Types of construction project- Types of construction equipment- Safety Management - Safety measures	
Unit-2 - Earthwork Equipment in Construction Projects	***9 Hour***
Earth Moving operations - Types of Earthwork Equipment- Earthwork Equipment – Tractors- capacity calculations- Earthwork Equipment - Motor Graders – Productivity calculations - Earthwork Equipment – Scrapers- Earthwork Equipment -Productivity calculations - Front end Loaders – Productivity calculations - Earthwork Equipment – Bulldozer calculations - Earthwork Equipment – Excavators- capacity calculations - - General safety in excavations- Application of AI in Excavator	
Unit-3 - Dewatering System in Construction Projects	***9 Hour***
Dredging equipment - Types of Dredging equipment- Types of trenching equipment - Concept of Pipe jacking techniques- Equipment Used for Box Jacking Techniques -Equipment used for Pipe jacking- Compaction equipment- Types of Compaction equipment- Pumping and Dewatering equipment- Types of pumps- Well point Dewatering system- Vacuum dewatering of concrete flooring- Pile Driving Equipment - Types and methods - Concept of Coffer dam - Sheet piling Tunneling equipment - Methods of tunneling- Case studies on Tunneling system- Tunnel forming formwork system.	
Unit-4 - Ready Mix Concrete in Construction Industry	***9 Hour***
Drilling equipments - Types of Drilling equipment- Principles of Blasting - Types of Blasting equipment - Aggregate production equipment – Crusher - Various types of crushers, feeders and screening equipments - Concrete mixers - Types of concrete mixers - Pouring and pumping of concrete – Precautions - Ready mix concrete - concept and procedure- Maintenance in RMC plant- Demolition equipment - Controlled demolition techniques – Case studies on Demolition. Lifting equipments - Material handling equipments - Hoisting Equipments - Types and safety precautions - Equipments for Conveyors - Types of Conveyors	

Unit-5 - Advancement in Construction Equipments	***9 Hour***
Slip form techniques – Self climbing formwork- Mivan formwork system- Prestressing techniques - Insitu prestressing in high rise structures - Aerial transportations - Applications and applications - Robots in construction - Different automated equipments - Conventional plastering machines - Use of robots for repetitive activities - Drones in construction- Advantages of drones- AI application in Equipment's- Computerized maintenance management system with case study,	

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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. G. Murali, Manager, Srivari Foundation, gmuralioffice@gmail.com*	1. *Dr. J. Saravanan, Associate professor Annamalai University, ausjs5070@gmail.com*	1. *Dr. S.Prakash Chandar, SRMIST*
2. *Mr. K. M. Nanthan, , L&T, rkmnnn@lntecc.com*	2. *Dr. S. Karthiyaini Associate professor VIT – Chennai*	2. *Dr. N. Ganapathy Ramasamy,SRMIST*

Course Code	21CEE411T	Course Name	CONTRACT MANAGEMENT	Course Category	E	PROFESSIONAL ELECTIVE	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:	*study the Indian Contract Act and understand the legal aspects of various construction contracts*
CLR-2:	*classify different tenders and contracts and apply them in diverse projects*
CLR-3:	*learn construction disputes and their resolution processes*
CLR-4:	*know about taxations and various construction finances leading into a project*
CLR-5:	*explore the constitutional provision regarding labour laws and requirements*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*identify various contracts and tenders according to the construction projects*	*3*	*3*	-	-	-	*2*	-	*3*	*3*	*2*	*1*	*2*	*3*	-	-
CO-2:	*apply the acquired knowledge to execute a contract and FIDIC*	*3*	*3*	-	-	-	*2*	-	*3*	*3*	*2*	*1*	*2*	*3*	-	-
CO-3:	*use dispute resolution process to mitigate construction disputes*	*3*	*3*	-	-	-	*2*	-	*3*	*3*	*2*	*1*	*2*	*3*	-	-
CO-4:	*develop skill required for construction financing and taxing process*	*3*	*2*	-	-	-	*3*	-	*3*	*2*	*2*	*2*	*2*	*3*	-	-
CO-5:	*learn about labour laws and limitations*	*3*	*2*	-	-	-	*2*	-	*3*	*2*	*2*	*1*	*2*	*3*	-	-

Unit-1 - Contracts and Tenders	***9 Hour***
Introduction to Indian Contract Act, Definitions, contract nomenclature, Types of Contracts and design process – Tenders and types – Documents and Notice Inviting Tender.	
Unit-2 - Tendering and Contract Management	***9 Hour***
Tender pre-qualification process, EMD & SD, Two Cover system, Bidding and Accepting, Potential Contractual problems, Law of Torts, Breach of Contract, FIDIC contracts.	
Unit-3 - Dispute Resolution	***9 Hour***
Construction Claims, types and documentation problems, Arbitration and Conciliation Act, Arbitrators- Powers, Dispute Review Boards, Alternative Dispute Resolution.	
Unit-4 - Construction Financing	***9 Hour***
Tax laws in India – past and present, Insurance-types, Legal Requirement for planning, Property law, Agency law, Real Estate – functioning, risks and opportunities, regulations	
Unit-5 - Labour Law	***9 Hour***
Labour laws and regulations, Labour rights, duties and bonus Child labour Act, Maternity Act, Minimum wages Act, Compensation Act, Industrial Dispute Act, Contract Labour Act.	

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://onlinecourses.nptel.ac.in/noc22_lw06/preview*

Learning Assessment							
	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers		
Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. K. M. Nanthan, L&T, RKMNNN@Intecc.com*	1. *Dr. A.R. Krishnaraja, Kongu Engineering college, krajacivil@kongu.ac.in*	1. *Dr. S. Anandh, SRMIST*
2. *Mr. Rajeev Srinivasan, NASS Contacting, Rajeev.srinivasan@nasscontracting.com*	2. *Dr. S. Kamal, University College of Engineering, Ramnad, kamalselva21@gmail.com*	2. *Dr. N. Pannirselvam, SRMIST*

Course Code	21CEE412T	Course Name	REPAIRS AND REHABILITATION TECHNIQUES	Course Category	E	PROFESSIONAL ELECTIVE	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:	*study the various building defects and causes*
CLR-2:	*analyze the building damages and failures by testing and maintenance*
CLR-3:	*identify the various building repair materials*
CLR-4:	*identify the various techniques used for building repairs and demolishing and dismantling structures*
CLR-5:	*understand the various techniques used for structural strengthening of the structures*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*understand the knowledge of building deterioration and its causes*	*3*	-	-	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-2:	*apply the knowledge of assessing building stability and maintenance*	*3*	-	-	-	*3*	-	-	-	-	-	-	-	*3*	-	-
CO-3:	*recognize the selection of various building repair materials and applications*	*3*	-	-	-	-	-	-	-	-	-	-	*2*	*3*	-	-
CO-4:	*apply the knowledge of techniques used for building repairs and demolition of the distressed structures*	*3*	-	*2*	-	-	-	-	-	-	-	-	-	*3*	-	-
CO-5:	*understand the comprehensive knowledge of strengthening of various structural members*	*3*	*2*	-	-	-	-		-	-	-	-	-	*3*	-	-

Unit-1 - Building Defects and Causes ***9 Hour***

Introduction - Concrete structure damages - defects and causes of defects, Environmental agencies - Thermal movements and cracking, rain water, Vegetation and tress -Roots damaging buildings, Minimize thermal cracking, Possible solution for damages due to environmental agencies, Creep and shrinkage, Permeability of concrete - Damage by carbonation, Cracks causes - Classification of cracks and remedial measures, Poor construction practices, Poor structural design and specification, Poor maintenance, Indiscrimination addition and alternation

Unit-2 - Building Forensic Engineering ***9 Hour***

Definition -methodology for forensic inspection, Assessment procedure for evaluating damaged structural members, NDT methods - Testing for Concrete quality, Testing for Compressive strength, surface hardness, Damage due to steel reinforcement corrosion - Corrosion mechanism of reinforcement, Testing for Chloride concentration, Testing for Corrosion rate, percentage of corrosion, corrosion progress, Maintenance – definitions, objectives, Phases of maintenance – Definition- classification and Objectives of various classification of maintenance, Remedial measures and controlling various defects in existing structure such as carbonation, creep, shrinkage and corrosion, Controlling various errors in building design and construction

Unit-3 - Materials for Repair ***9 Hour***

Selection of materials Special concretes- high strength, high performance etc,. Polymer concretes - concrete chemicals, Expansive cement - Special mortars - Unmodified Portland Cement Mortar – Grout, Latex Modified Portland Cement Mortar / Concrete, Quick Setting Non-shrink Mortar, Sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete- Definition, applications, Properties of FRC as a repair material, Epoxy resin and mortar, Rust eliminators and polymers coating for rebars- dry pack, Cement based repair materials, Carbon fibre reinforced wrap, Materials for damp proofing

Unit-4 - Repairing and Demolition Techniques ***9 Hour***

Repair surface preparation- Selection of materials, Repair of masonry Cracks, Repair of masonry Cracks, Repair of dampness, efflorescence, etc., Methods of Concrete Column, beam and slab Repair for Damages and Cracks, Methods of Concrete Column, beam and slab Repair for Damages and Cracks, Epoxy injection methods, Grouting and polymer sealing -Polymer impregnations, Sprayed concrete – Guniting, Shotcrete, Repair of Rainwater Leakage in Buildings, Control on Termites, Demolition techniques · Non Engineering Demolition - Manual Demolition, Engineering Demolition - Mechanical Method - Wrecking Ball, Pusher Arm technique -Concrete Sawing Method - Thermic Lance Technique, Implosion, Non – explosive demolition

Unit-5 - Strengthening of Structures	***9 Hour***
General measures and principles, Assessment procedure for evaluating and strengthening of structure, strengthening of masonry walls, strengthening concrete walls, Strengthening of RCC beams, Strengthening of RCC columns, strengthening of slabs, strengthening of foundations – load bearing type, Strengthening of RCC footing and pile foundation – underpinning, Stress reduction techniques, Strengthening by post tensioning	

Learning Resources	1. *Maintenance, Repair & DELHI Rehabilitation and Minor Works of Buildings P. C. Varghese PHI* 2. *Concrete Structures, Materials, Maintenance and Repair Denison Campbell, Allen and Harold Roper Materials, Maintenance and Repair* 3. *Forensic Engineering: Damage Assessments for Residential and Commercial, edited by Stephen E. Petty*	4. *Building Repair and Maintenance Management P. S. Gahlot CBS Publishers and Distributors Pvt Ltd.* 5. *Building Construction Dr. B. C. punamia Laxmi Publications, New Delhi* 6. *Repair of Concrete structures R.T.Allen and S.C.Edwards Blakie and Sons, UK* 7. *Handbook on Repairs and Rehabilitation of Structures CPWD,Delhi* 8. *Maintenance And Repair of Concrete Structures – NPTEL*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr.C. Velan, City Hea Executive Director & CEO d, Ascendas, Taramani, velan62@yahoo.com*	1. *Dr. S. Kamal, Assistant Professor, University college of Engineering, Ramnad, kamalselva21@gmail.com*	1. *A. Arokiaprakash, SRMIST*
2. *Mr. K. M. Nanthan, Planning Manager south Factories, L&T, RKMNNN@Intecc.com*	2. *Dr. K.Yogeswari, Associate Professor, B.S. Abdur Rahman Crescent Institute of Science and technology, yogeswari@crescent.edu.in*	2. *Dr. N. Pannirselvam, SRMIST*

Course Code	21CEE413T	Course Name	SUSTAINABLE CONSTRUCTION METHODS	Course Category	E	PROFESSIONAL ELECTIVE	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:	*know the basic concepts of functional requirement of building*
CLR-2:	*explore the advanced concepts of green building construction*
CLR-3:	*learn various concepts and applications of BIM*
CLR-4:	*understand the various lean tools for sustainable construction*
CLR-5:	*explore the knowledge in the field of energy efficiency of buildings*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*apply the knowledge of planning, orientation, and selection of modern material for green building concepts*	*3*	-	-	-	-	-	*3*	-	-	-	*3*	*2*	*3*	-	-
CO-2:	*gain the knowledge of rating system for certification of green building*	*3*	-	-	-	-	-	*3*	-	-	-	*3*	*2*	*3*	-	-
CO-3:	*utilize various concepts and applications of BIM*	*3*	-	-	-	-	-	*3*	-	-	-	*3*	*2*	*3*	-	-
CO-4:	*apply the lean tools for sustainable construction*	*3*	-	-	-	-	-	*3*	-	-	-	*3*	*2*	*3*	-	-
CO-5:	*accrue comprehensive knowledge in the field of energy efficiency of buildings*	*3*	-	-	-	-	-	*3*	-	-	-	*3*	*2*	*3*	-	-

Unit-1 - Formwork Techniques & Building Orientation ***9 Hour***

Introduction Basics of formwork and staging, Form work materials, Types of form work, Advancement of form work Systems, Formwork for structural system, Principles of planning, Planning regulations and byelaws, Orientation of building, Functional requirements of a building, Life-cycle assessment of construction building, Engineering materials, Sustainable building materials, Environmental impact of materials, Advantage and disadvantage, Material selection to optimize performance process for selection, Green construction materials.

Unit-2 - Environmentally Friendly and Sustainable Construction Methods ***9 Hour***

Prefabricating Materials in Controlled Environments - Construction Waste Management - Passive Solar Design - Environmentally-Friendly Insulation Materials - Active Solar Power - Electric Smart Glass - Water Efficient Gray-water Recycling System and Dual Plumbing System – Using Biodegradable Materials - Rammed Earth Material - Harnessing Wind Power - Durable Wood Materials - IoT Integrated Automated Building Systems

Unit-3 - Green Building for Sustainability ***9 Hour***

Green building – Introduction, Benefits of green buildings, Green building materials and equipment in India, Key requisites for constructing a green building, Important sustainable features for green building, Indian green building council, Green building moment in India, Benefits experienced in green Buildings, Launch of green building rating systems, Residential sector, Opportunities of green building, Green building features, LEED India rating system, Parameters for rating system, HVAC system for green building, Design philosophy

Unit-4 - Modern Tools for Sustainability ***9 Hour***

BIM –Introduction, Software's used for building information modeling, Categories of BIM, BIM in project development stage, BIM in design stage, BIM in implementation stage, BIM in maintenance of buildings, Lean concepts, Application of lean tools in construction, General principles of passive solar heating, General principles of passive cooling, Thermal design of buildings Influence of design parameters – mechanical controls, Direct gain – trombe walls, water walls radiant barriers, glazing material, Ventilation –requirements – minimum standards for ventilation, Ventilation design ,energy conservation, Ventilating systems – design for natural ventilation, Ventilation – requirements – minimum standards for ventilation

Unit-5 - Energy Efficiency	***9 Hour***
Energy and environment, Energy efficiency and conservation, Introduction to clean energy technologies, Importance in sustainable development, Energy consumption and sustainability, Future energy use - influenced by economic and environmental factors, Identification of energy related enterprises that represent the breath of the industry, Energy modeling, Use as a tool for measuring sustainability, Energy audit of facilities, Optimization of energy consumption, Energy efficiency ,an overview of design concepts, and architectural interventions, 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 (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*20%*	-	*20%*	-	*20%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*30%*	-	*30%*	-	*30%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Ravikumar Devarajan, Director, Project Management Services, Savills, ravi.devaraj@savills.in*	1. *Dr. K.Yogeswari, Professor, B.S. Abdur Rahman Crescent Institute of Science and technology, yogeswari@crescent.education*	1. *Dr. V.R.Prasath Kumar , SRMIST*
2. *Ms. K. S Sindhu, L&T, sindhubtechcivil@gmail.com*	2. *Dr. S. Kamal, Associate Professor, University College of Engineering, Ramnad, kamalselva21@gmail.com*	2. *Dr. L.Krishnaraj, SRMIST*

Course Code	21CEE414T	Course Name	BIM IN CONSTRUCTION MANAGEMENT	Course Category	E	PROFESSIONAL ELECTIVE	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:	*acquire the knowledge on the approaches to set up a project to succeed*
CLR-2:	*identify the focus area for the use of the BIM tools in construction*
CLR-3:	*learn the nuts and bolts of using BIM and technology during the construction process*
CLR-4:	*know about the BIM effectiveness at the project completion stage*
CLR-5:	*enable the learner to know about the future of construction with BIM*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*recognize the concept of information flow in construction management*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	*3*	*3*	-
CO-2:	*identify the roles and responsibility of project participants in a project*	*3*	-	-	-	-	-	-	-	-	-	*3*	-	*3*	*3*	-
CO-3:	*understand the growth and use of BIM in the area of preconstruction*	*3*	-	-	-	*3*	-	-	-	-	-	*2*	-	*3*	*3*	-
CO-4:	*apply the concept of BIM and technology during the construction process*	*3*	-	-	-	*2*	-	-	-	-	-	*2*	-	*3*	*3*	-
CO-5:	*disseminate the knowledge on the applications of BIM in the project closing out*	*3*	-	-	-	*2*	-	-	-	-	-	*2*	-	*3*	*3*	-

Unit-1 - BIM Based Project Planning	***9 Hour***
Introduction to BIM - Fundamental uses of BIM -Application of BIM - Model based Coordination, Scheduling, Facilities management & Analysis - BIM execution planning - Delivery methods – DBB, DB & Integrated project delivery – Project Simulations	
Unit-2 – BIM in Pre-Construction	***9 Hour***
Creating the vision, opening line of communication - Scheduling Design - Design structure matrix - Constructability review - Revit schedules for Estimating - Sustainability Analysis	
Unit-3 - BIM During Construction	***9 Hour***
BIM and site coordination - Clash detection - BIM Scheduling - System installation for management and verification - Activity tracking - Field issue management - BIM and Safety - Document control	
Unit-4 - BIM close out and user applications	***9 Hour***
Artifact and constant deliverables –Handover information – Facility management - BIM for Owners, Architects & Engineers, Contractors, Sub-contractors and Fabricators	
Unit-5 - Future of BIM and Buildings	***9 Hour***
Process and Technology trends - Digital design and construction - new culture of innovation –AI in construction – Globalization –Virtual walk throughs – Sustainable construction – BIM case studies	

Learning Resources	1. *Brad Hardin, Dave McCool, BIM and Construction Management proven tools, method and workflow, John Wiley & Sons, Inc., Indianapolis, Indiana, Second edition, 2015* 2. *Rafael Sacks, Charles Eastman, Ghang Lee, Paul Teicholz, BIM Handbook A Guide to Building Information Modeling for Owners, Designers, Engineers, Contractors, and Facility Managers, John Wiley & Sons, Inc., Hoboken, New Jersey, Third edition, 2018*	3. *Dana K Smith, Michael Tardif, Building Information Modeling A Strategic Implementation Guide for Architects, Engineers, Constructors, and Real Estate Asset Managers, John Wiley & Sons, Inc., Hoboken, New Jersey, 2009* 4. *John Eynon, Construction Manager BIM Handbook, John Wiley & Sons Ltd, UK 2016* 5. *Nawari O. Nawari & Michael Kuenstle, Building Information Modeling: Framework for Structural Design, CRC Press,Taylor and Francis group, Boca Raton, 2015.*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	*20%*	-	*20%*	-
Level 2	*Understand*	*30%*	-	*30%*	-	*30%*	-
Level 3	*Apply*	*30%*	-	*30%*	-	*30%*	-
Level 4	*Analyze*	*20%*	-	*20%*	-	*20%*	-
Level 5	*Evaluate*	-	-	-	-	-	-
Level 6	*Create*	-	-	-	-	-	-
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Dr. K. M. Nanthan, Planning Manager south Factories, L&T, rkmnnn@lntecc.com*	1. *Dr. Sivakumar Palaniappan, IIT Madras, sp@iitm.ac.in*	1. *Dr. S. Manikandaprabhu alias Saravanan, SRMIST*
2. *Dr.C. Velan, City Hea Executive Director & CEO d, Ascendas, Taramani, velan62@yahoo.com*	2. *Dr. Sagar Malsane, NICMAR, Pune, smalsane@nicmar.ac.in*	2. *Dr.N.Pannirselvam, SRMIST*

Course Code	21CEE415T	Course Name	MODERN CIVIL ENGINEERING ECONOMICS	Course Category	E	PROFESSIONAL ELECTIVE	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:	*comprehend the basic principles of economics and know earthwork estimation*
CLR-2:	*realize the type of firm and market structure and know estimation of masonry work*
CLR-3:	*understand the concept of Indian economy and learn the estimation of finishes, bridges and culverts*
CLR-4:	*know the types of construction specification and learn the estimation of MEP works*
CLR-5:	*explore rate analysis*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	Program Outcomes (PO)												Program Specific Outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12			
		Engineering Knowledge	Problem Analysis	Design/development of solutions	Conduct investigations of complex problems	Modern Tool Usage	The engineer and society	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO-1	PSO-2	PSO-3
CO-1:	*recognize the various economic policies and analyze the earthwork estimation*	*3*	-	-	-	-	-	*3*	-	-	-	-	-	*3*	-	-
CO-2:	*identify the forms of market structure and organization and apply estimation of masonry work*	*3*	-	-	-	-	*2*	-	-	-	-	-	-	*3*	-	-
CO-3:	*apply the concepts of time value of money and estimation of finishes, bridges and culverts*	*3*	-	-	-	*2*	-	-	-	-	-	-	-	*3*	-	-
CO-4:	*extract the specification for different types of buildings and estimation of MEP works*	*3*	-	-	-	-	*3*	-	-	-	-	-	-	*3*	-	-
CO-5:	*interpret the factors affecting rate analysis*	*3*	-	-	-	-	-	*3*	-	-	-	-	-	*3*	-	-

Unit-1 - Economics Basics	***9 Hour***
Basic principles and methodology of economics - Demand/supply - Government policies and application - Basic Macro-economic concepts - GDP/GNP/NI/Disposable income - Public sector economics –welfare, externalities, labour market - Components of Monetary and financial system – Central bank –monetary aggregates, commercial banks & Their functions - Capital and debt markets, elements of business/managerial economics	
Unit-2 - Cost Management	***9 Hour***
Forms of organizations - Cost & cost control –techniques - Types of costs - Break even analysis - Budgets-Capital Budgeting - Application of linear programming - Investment analysis – NPV problem - ROI problem - Payback Period-Problem - Bid price - Evaluation of bids - RA bills – Final bills - time value of money	
Unit-3 - Estimation of Materials	***9 Hour***
Types of estimation – Load bearing structure by centre line method – Load bearing structure by long wall short wall method - Framed structure – BBS for column footing – BBS for Beam and slab – estimation of trusses – estimation roads – Estimation of bridge	
Unit-4 - Rate Analysis	***9 Hour***
Specifications-types, requirements and importance - Detailed specifications for buildings - rate analysis - purpose, importance, necessity - Factors affecting rate analysis – calculation of quantities of materials for concrete and brick work – Calculation cost of materials for items of work – Bill of quantities	
Unit-5 - Valuation	***9 Hour***
Value – Types of values – Method of valuation for land and buildings - Depreciation – Types of depreciation – Obsolescence – Calculation of depreciation using straight line, constant percentage and sinking fund method, Rent and lease – Rent calculation - Annuity	

Learning Resources	1. *Mankiw Gregory N. (2002), Principles of Economics, Thompson Asia* 2. *V. Mote, S. Paul, G. Gupta (2004), Managerial Economics, Tata McGraw Hill* 3. *Misra, S.K. and Puri (2009), Indian Economy, Himalaya* 4. *Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers*	5. *Typical PWD Rate analysis documents.* 6. *Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS publishers, 2016* 7. *Introduction to Accounting and Finance for Civil Engineers – NPTEL Online course*

Learning Assessment

	Bloom's Level of Thinking	*Continuous Learning Assessment (CLA)*				*Summative Final Examination (40% weightage)*	
		Formative CLA-1 Average of unit test (50%)		*Life-Long Learning CLA-2 (10%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 2	*Understand*	*20%*	*-*	*20%*	*-*	*20%*	*-*
Level 3	*Apply*	*30%*	*-*	*30%*	*-*	*30%*	*-*
Level 4	*Analyze*	*30%*	*-*	*30%*	*-*	*30%*	*-*
Level 5	*Evaluate*	*-*	*-*	*-*	*-*	*-*	*-*
Level 6	*Create*	*-*	*-*	*-*	*-*	*-*	*-*
	Total	*100 %*		*100 %*		*100 %*	

Course Designers

Experts from Industry	**Experts from Higher Technical Institutions**	**Internal Experts**
1. *Mr. Rajeev Srinivasan, Senior Planning, NASS Contacting.*	1. *Dr. A.R. Krishnaraja, Associate professor, Kongu Engineering College.*	1. *Dr. J. Rajprasad, SRMIST*
2. *Dr. N. Arivu Sudar, FOSROC, India.*	2. *Dr. J. Saravanan, Associate Professor, Annamalai University.*	2. *Dr. S. Manikandaprabhu alias Saravanan, SRMIST*

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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