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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Regulations 2021

SRM INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)

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	21CEE313J	Course Name	COMPUTER AIDED GEOTECHNICAL INVESTIGATIONS	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*understand the various concepts of soil exploration and plan the subsurface investigation program for a real time soil mechanics and foundation engineering problems*
CLR-2:	*explore the various field test methods, sampling techniques and data interpretation for field application*
CLR-3:	*know and apply data correlation for field and design parameters for geotechnical practical filed application*
CLR-4:	*comprehend the concepts of indirect geophysical methods and deriving the design parameters*
CLR-5:	*utilize modern software tool to data interpretation and develop knowledge through parametric studies*

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:	*illustrate the various concepts of soil exploration and plan the subsurface investigation program*	*3*	*3*	*-*	*-*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*3*
CO-2:	*carryout appropriate field test of soil exploration to arrive at required soil parameters for the design of geotechnical structures*	*3*	*3*	*-*	*-*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*3*
CO-3:	*Appraise the field tests and correlate to soil properties and adopt for the design methods in geotechnical engineering*	*3*	*3*	*-*	*-*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*3*
CO-4:	*apply the knowledge of indirect methods in soil exploration and interpret soil behaviour based on the results*	*3*	*3*	*-*	*-*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*3*
CO-5:	*explain the technical knowledge to model the soil behavior in software and visualize the behavior with respect to field scale*	*3*	*3*	*-*	*-*	*3*	*-*	*-*	*-*	*-*	*-*	*-*	*-*	*3*	*3*	*3*

Unit-1 - General	***12 Hour***
Scopes and objectives of soil exploration-planning subsurface investigation-stages-preparation of borelogs- programming for computer aided borelog creation-practice on soil profiling-computer aided data sheets for basic soil properties and engineering properties	
Unit-2 - Methods of Soil Exploration	***12 Hour***
Boring methods-soil sampling-samplers-insitu testing techniques-SPT, CPT, field permeability-ground monitoring devices-inclinometers-accelerometers-Analysis of data-setting macro templates for data entry and interpretation	
Unit-3 - Correlation of Field Test Data	***12 Hour***
Correlation of SPT N values and soil properties; CPT data interpretation-Computation of SBC of soil-programming in excel to compute SBC of soil- foundation recommendation based on field obtained parameters	
Unit-4 - Geophysical Methods	***12 Hour***
Need for geophysical methods-Types of geophysical soil exploration methods-Electrical Resistivity Method – Electrical Profiling method--Interpretation of results from Electrical Profiling Method-Seismic refraction method- Data interpretation- preparation of soil classification specification	
Unit-5 - Modern Tools	***12 Hour***
Introduction to software tools-creating boreholes-cross-section-soil profiles-Understanding input data and map generation- Practice Sessions	

Practice -
Practice 1 : Introduction to Macros in Excel
Practice 2 : Preparation of data sheets for laboratory experiments through excel programming
Practice 3 : preparation of borelog sheets and generation of soil profiling
Practice 4 : Creating data base with soil parameters collected through SPT/CPT/Permeability tests
Practice 5 : Interpreting the data and classification of soil
Practice 6 : Creation of data base with soil properties for specific locations
Practice 7 : Preparation of excel macro templates for SPT and CPT
Practice 8 : Plugin correlation relationship for field testing and soil parameters
Practice 9: Computation of SBC, through excel programming and foundation recommendation
Practice 10 : Preparation of data entry sheets for geophysical methods
Practice 11 : Data correlation sheet preparation through excel programming
Practice 12 : computation of SBC, through excel with all data correlations
Practice 13 : Installation and introduction to software tools
Practice 14 : Practice session on creating borehole profiles and soil profiles
Practice 15 : Generation of Maps with various geological features

Learning Resources	1. *V.N.S. Murthy, "Soil Mechanics & Foundation Engineering Vol. 2", Sai Kripa Technical Consultants, Bangalore.* 2. *C. Venkataramaiah, "Geotechnical Engineering", Wiley Eastern Ltd., New Delhi.* 3. *Terzaghi K., Peck R.B., Soil Mechanics in Engineering Practice, John Wiley Ltd., 1967.* 4. *Arora .K.R, "Soil Mechanics and Foundation Engineering", Standard Publication Distributors, 2011.*	5. *Hvorslev, "Sub surface exploration and Sampling of soils for Civil Engineering Purpose", M.J. Waterways Station, Vicksburg, Missispi, 1949.*

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%*	-	-	*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. Srinivasa Rao, Saipem India Pvt Ltd*	1. *Dr. M. Muttharam, Professor, Anna University*	1. *Dr. P.T. Ravichandran, SRMIST*
2. *Er. Anirudhen, Geotechnical Solutions Pvt.Ltd*	2. *Dr. Rakesh Pillai, IIT Palakkad, rakeshpilla@iitpkd.ac.in*	2. *Dr. S. Bhuvaneshwari, SRMSIT*

Course Code	21CEE314J	Course Name	COMPUTER APPLICATION IN GEOTECHNICAL ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*understand the essential steps involved in Geotechnical application using PLAXIS*
CLR-2:	*explore specific field problems using PLAXIS 2D*
CLR-3:	*know simulation of field problems using PLAXIS 3D*
CLR-4:	*comprehend the design concepts involved in Geotechnical application using PLAXIS*
CLR-5:	*address the modelling steps in Geoenvironmental Engineering using SCILAB*

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 basic concepts in foundation modelling*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*
CO-2:	*illustrate concepts to model deep excavation problems and tunneling*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*
CO-3:	*apply basic concepts of PLAXIS 3D, FLAC-2D and 3D*	*3*	*3*	-	*2*	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*
CO-4:	*appraise the basic concepts of PLAXIS and derive the model in slope stability analysis using PLAXIS*	*3*	*3*	-	*2*	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*
CO-5:	*solve contaminant flow problems using SCILAB*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*

Unit-1 - Introduction to Numerical Modelling and Basics of PLAXIS 2D	***12 Hour***
Concept of finite element analysis, 2D and 3D idealization of practical problems, Basics of PLAXIS modelling, interpretation of input parameters, foundation analysis- understanding load settlement behavior. practice sessions on rigid and flexible footing- calculation of settlement and load, understanding deformation patterns, stress and strain contours	
Unit-2 - Analysis of Specific Field Problems in PLAXIS 2D	***12 Hour***
Analysis of submerged excavation- understanding new soil models, undrained analysis-use of interface elements- construction of diaphragm wall, Modelling of settlements due to tunnel construction-modelling of tunnel boring process, modelling of undrained behaviour-understanding the deformation after tunneling process, Practice session	
Unit-3 - Introduction to PLAXIS 3D	***12 Hour***
PLAXIS 3D- understanding advanced modeling through soil-structure interaction-material models-realistic assessment of stresses and displacements for soil-pile interaction	
Unit-4 - Application of GEOSLOPE and GEO5	***12 Hour***
Slope stability analysis - Ordinary method of analysis, Bishop's method of analysis, Geoslope background and features, Analysis of slope stability problems with homogenous and layered soil strata. Modelling concepts; stability analysis and design of cantilever retaining wall. Design of gravity retaining wall, Practice session	
Unit-5 - Introduction to Geoenvironmental Modeling	***12 Hour***
Concepts of contaminant flow in soil- diffusion-convection- dispersion- application of SCILAB for solving contaminant flow problems- understanding concepts of sorption and attenuation. Contaminant transport modeling through saturated and unsaturated soils, Practice session	

Practice -
Practice 1: Introduction to PLAXIS 2D
Practice 2: Practice session on Rigid and Flexible footing
Practice 3: Parametric study on foundation behaviour with sand and clay soil
Practice 4: Creating geometric model and simulation of excavation through staged construction
Practice 5: Understanding the deformation behaviour of the diaphragm wall
Practice 6: Modelling of tunneling process, assessment of bending moments, axial forces in tunnel components.
Practice 7: Introduction to PLAXIS 3D and advanced soil models
Practice 8: Soil structure interaction for Pile foundations
Practice 9: Modelling of piled raft foundations and parametric study
Practice 10: Computation of FoS for different slope configuration and seepage conditions
Practice 11: Computation of FoS for different slope stability methods
Practice 12: Design of retaining walls using PLAXIS
Practice 13: Modelling of contaminant flow in SCILAB
Practice 14: Modelling diffusion, dispersion and convection flows
Practice 15: Modelling the effect of attenuation, soil properties and saturated and unsaturated conditions

Learning Resources	1. *Foundation Analysis and Design, Joseph E. Bowles, The McGraw-Hill publications.* 2. *Das B.M, "Principles of Foundation Engineering", (Fifth Edition), Thomson Books, 2010.* 3. *Michael A. Hicks, Ronald B.J. Brinkgreve, Alexander Rohe, Computer Application in Geotechnical, Taylor and Francis Group, CRC Press.*	4. *Finite Element Code for soil and Rock Analyses, R.B.J. Brinkgreve, Netherlands.* 5. *Geo studio tutorials, GEO – Slope International Ltd, http://www.geo-slope.com*

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%*	-	-	*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. Srinivasa Rao, Saipem India Pvt Ltd*	1. *Dr. M. Muttharam, Professor, Anna University*	1. *Dr. P.T. Ravichandran, SRMIST*
2. *Er. Anirudhen, Geotechnical Solutions Pvt.Ltd*	2. *Dr. Ganesh Kumar, CBRI, Roorkee*	2. *Dr. S. Bhuvaneshwari, SRMIST*

Course Code	21CEE315J	Course Name	COMPUTER APPLICATION IN ENVIRONMENTAL ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*analyze and identify the water and waste water in distribution*
CLR-2:	*prediction of data quality*
CLR-3:	*preparation of map with GIS software*
CLR-4:	*understand various options available in QGIS and watershed models*
CLR-5:	*understand basics of modelling using HEC-RAS*

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 identify the water and waste water in distribution*	*3*	*2*	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*
CO-2:	*prediction of data quality*	*3*	*2*	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*
CO-3:	*preparation of map with GIS software*	*3*	*2*	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*
CO-4:	*understand various options available in QGIS and watershed models*	*3*	*2*	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*
CO-5:	*understand basics of modelling using HEC-RAS*	*3*	*2*	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*

Unit-1 - Water Distribution Network — ***12 Hour***

Introduction – sources – applications for modelling drinking water distribution systems – analyzing the water transmission piping systems – identifying the length of water pipeline using open access software – simulation of hydraulic and water quality behavior – calibration statistics for chemical characteristics with elevation – base demand – initial quality – head and pressure – contour plots for the specific characteristics of water and waste water – network mapping for distribution of water and waste water.

Unit-2 - Numerical Data Analysis — ***12 Hour***

Basics - introduction – installation of open-source software – key features – importance and applications of software – various fields of applications – advantages and disadvantages – program writing- prediction of future population-exponential growth curve- S-curve- sewer design-gradient of sewer lines-saving data files – basic language concepts- results interface-tables – graphs – output of the program – practical application of software in environmental Engineering.

Unit-3 - Ground Water Analysis — ***12 Hour***

An overview of the software and its practical applications – various data sources – data formats – creating a model - Introduction – geo-graphical information system tools in environmental applications – identifying suitable site for solid waste disposal – landfill area calculation – analyzing the parameters for ground water potential zones – analyzing the parameters for water quality index – ground water potential zone mapping – water quality index mapping.

Unit-4 - Water Shed Analysis — ***12 Hour***

Installation and overview of software used for water shed analysis – working with google earth and quick map services – vector data set – raster data set – process of digitization: vector and raster – geo-referencing – conversion of KML format to required dataset – topo sheet – analyzing the area of influence with Thiessen polygons – flood inundation mapping using buffering

Unit-5 - Surface Water Modelling — ***12 Hour***

Introduction to contour extraction from google earth – google earth engine – overview of software utilization – practical applications – various data sources and data formats required for creating a model – importing maps and images for digitization.

Learning Resources	1. *S.K.Garg, Water Supply Engineering, Khanna Publishers, NewDelhi, 2017* 2. *User manual of open source software* 3. *CPHEEO Manual on Water Supply and Treatment, Ministry of Drinking water and Sanitation, New Delhi, 2015*	4. *IS:10500-2012, Indian Standards for Drinking Water, Bureau of Indian Standards, New Delhi* 5. *https://www.youtube.com/HEC-RAS Tutorials* 6. *https://www.scilab.org Tutorials*

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%*	-	-	*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	21CEE316J	Course Name	COMPUTER APPLICATION IN ENVIRONMENTAL IMPACT ASSESSMENT	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*understand Importance of EIA and its evolution*
CLR-2:	*learn principles and methods of environmental analysis*
CLR-3:	*know the interrelationship between various activities and their impact on environment*
CLR-4:	*understand the Application of EIA in various sectors*
CLR-5:	*explain the concept of environmental management*

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 importance of various rules & regulation in EIA and role of stake holders in EIA*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	*3*	*3*
CO-2:	*apply various techniques in Impact Assessment studies*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	*3*	*3*
CO-3:	*analyze the Impact on Water, land and soil environments using various tools*	*3*	-	-	-	*2*	-	*3*	-	-	-	-	-	*3*	*3*	*3*
CO-4:	*analyze the Impact on Air, Noise, Biota and Socio-Economic environments using various tools*	*3*	-	-	-	*2*	-	*3*	-	-	-	-	-	*3*	*3*	*3*
CO-5:	*evaluate the Impact using management plan and make suggestions*	*3*	-	-	-	-	*2*	*3*	-	-	-	-	-	*3*	*3*	*3*

Unit-1 - Introduction	***12 Hour***
Basic concepts of EIA- Overview of Environmental Laws- EPA 1986, Water Act, Forest Act- Practice 1: Review the evolution of Environmental Laws in India- Evolution: EIA Notification1994; 2006 and EIA Draft 2020- Practice 2: Compare EIA notifications 2006 and 2020- Types of EIA; Screening; Scoping- Role of Governmental and NGOs- Practice 3- Case study on types of EIA.	
Unit-2 - EIA Methodologies	***12 Hour***
Baseline Description; Environmental Examination- Screening; Scoping- Practice 4- Case study on screening & scoping; Methods- Checklist; Matrix; Network; Overlay; Cost Benefit Analysis- Practice 5- Case study on application of EIA methodology; Public participation; Analysis of Alternatives; Expert Systems- Practice 6- Case study on application of expert system for EIA.	
Unit-3 - Components of the Environment – Water, Land Soil	***12 Hour***
Setting Baseline; Impact Prediction and Assessment of- Water: Surface Water- Practice 7- Case study on application of expert systems in surface water Impact analysis; groundwater- Practice 8- Case study on application of expert systems in groundwater impact assessment; Land; Soil- Practice 9- Case study on application of expert systems in soil impact assessment; Case Studies.	
Unit-4 - Components of the environment – air, noise, biota, socio-economic	***12 Hour***
Setting Baseline; Impact Prediction and Assessment of- Noise Practice- 10- Application of expert systems for identifying noise impact- Air Environment- Practice 11- Application of expert systems for identifying air pollution impact- Biota; Socio-Economic; Cultural and Aesthetics- Practice 12- Case study on socio-economic impact assessment; Case Studies.	
Unit-5 - Environmental Management Plan	***12 Hour***
expert systems for integrated impact assessment- Environmental Mitigation; Risk Analysis; Environmental Audit- Practice 15- Case study on application of ISO19011; TOR preparation; Documentation and Report Preparation.	

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*

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%*	-	-	*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 EnvirocareSystems, Chennai.*	2. *Dr. Harish Gupta, Assistant Professor, Osmania University, Hyderabad*	2. *Dr. K. Prasanna, SRMIST*

Course Code	21CEE317J	Course Name	COMPUTER APPLICATION IN PAVEMENT DESIGN	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*understand and practice the concepts in the determination stresses and strains in layers structure*
CLR-2:	*understand and practice the concepts in the computation of traffic loads for the design of pavement*
CLR-3:	*understand the design of flexible pavement*
CLR-4:	*understand the universal design practices in the design of pavements*
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 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:	*analyze the stress and strain in the layered structure*	*3*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	-	-
CO-2:	*compute the traffic loads for the design of pavement*	*3*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	-	-
CO-3:	*design the pavement following Indian code of practice*	*3*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	-	-
CO-4:	*discriminate different codal practices in the design of pavements*	*3*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	-	-
CO-5:	*analyze the layered structure in the rigid pavement and design the pavement for critical conditions*	*3*	*3*	*3*	*3*	*3*	-	-	-	-	-	-	-	-	-	-

Unit-1 - Linear Elastic Analysis of Layered Structure	***12 Hour***
Overview of pavement design/distress - Single-layer stress-strain analysis – Introducing three-dimensional stress functions, Layered structure analysis - Boussinesq equation and numerical to determine stresses and strain at different locations of the layer - Two-layered and multi-layered structural analysis and determination of stresses and strain for a different combination of layers with numerical examples – Practice sessions	
Unit-2 - Traffic, Material and Climatic Characteristics	***12Hour***
Traffic characteristics – Traffic volume, growth rate, lane distribution factor, modal distribution, Axle configuration, Equivalent single wheel load for different criteria and Equivalent wheel load factor, Axle load survey, distribution, Truck factors, ESAL and computation of the number of repetitions with numerical examples - Material and climate – Soil characteristics, granular material characteristics, and bituminous material characteristics - Climate variation, estimation and prediction model, Influence of climate in material characteristic functions – Practice sessions	
Unit-3 - Pavement Design Based on Indian Code of Practice	***12 Hour***
IRC37 guidelines for flexible pavement design - IITPAVE software - Design examples based on the IRC37 method of pavement design – Practice sessions	
Unit-4 - Other Design Practices	***12 Hour***
Reliability in pavement design – AASHTO based MEPDG design - Nonlinear models – layered analysis – Introduction to linear viscoelasticity – Linear Viscoelastic models – Pavement layer analysis with the material exhibiting nonlinear behavior and viscoelastic behavior – Practice sessions	
Unit-5 - Design of Rigid Pavement	***12 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 – Practice sessions	

Practice -
Practice 1: Critical stress on the subgrade layer
Practice 2: Critical stress on the bituminous layer
Practice 3: Influence of layer thickness on the critical stresses
Practice 4: Computation of equivalent wheel load factor
Practice 5: Computation of number of standard axle load repetition
Practice 6: Application of time temperature superposition principle
Practice 7: Design of pavement with unbounded layers
Practice 8: Design of pavement with bonded layers
Practice 9: Overlay design
Practice 10: AASHTO method of pavement design – Traffic input
Practice 11: AASHTO method of pavement design – Temperature and Material function input
Practice 12: AASHTO method of pavement design – Distress characterization
Practice 13: Thermal stress in the rigid slab
Practice 14: Wheel load stress in the rigid slab
Practice 15: Design of Joints and dowel bars

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. *Yang Huang, Pavement Analysis and Design, Pearson, 2004* 4. *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 (45%)		*Life-Long Learning CLA-2 (15%)*			
		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	21CEE318J	Course Name	COMPUTER APPLICATION IN TRANSPORTATION ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

Pre-requisite Courses	Nil	Co- requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering	Data Book / Codes / Standards		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 alignment of highway
CLR-2:	understand and practice the concepts in the vertical alignment of highway
CLR-3:	simulate the traffic condition and study the traffic conflict points
CLR-4:	understand the design of flexible pavement
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 alignment of highway	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO-2:	design the vertical alignment of highway	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO-3:	design the road sections to reduce traffic conflict points	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO-4:	analyze the layered structure in the flexible pavement and design the pavement for critical conditions	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO-5:	analyze the layered structure in the rigid pavement and design the pavement for critical conditions	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3

Unit-1 - Highway Geometry and Horizontal Alignment **12 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 – Practice sessions

Unit-2 - Vertical Alignment of Highway **12 Hour**

Profiles and cross-sections - Vertical profiling -Creating 2D sketches and 3D models of highway cross-sections - Earth work calculation – Calculation of cut and fill – Surface analysis of highway – Practice sessions

Unit-3 - Traffic Flow Characteristic Study **12 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 – Practice sessions

Unit-4 - Design of Flexible Pavement **12 Hour**

Stress analysis of multi layered and two 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 – Practice sessions

Unit-5 - Design of Rigid Pavement **12 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 – Practice sessions

Practice -
Practice 1: Creation of terrain
Practice 2: Highway corridor creation
Practice 3: Horizontal alignment of Highway
Practice 4: Calculation of earthwork in cutting and embankment
Practice 5: Cross and longitudinal profiling of highway
Practice 6: Vertical alignment of Highway
Practice 7: Uninterrupted flow simulation
Practice 8: Simulation of uncontrolled intersection
Practice 9: Simulation of controlled intersection
Practice 10: Critical stress on the subgrade layer
Practice 11: Critical stress on the bituminous layer
Practice 12: Influence of layer thickness on the critical stresses
Practice 13: Thermal stress in the rigid slab
Practice 14: Wheel load stress in the rigid slab
Practice 15: Design of Joints and dowel bars

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 (45%)		*Life-Long Learning CLA-2 (15%)*			
		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*	*20%*	-	-	*20%*	*20%*	-
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	21CEE416J	Course Name	COMPUTER APPLICATION IN STRUCTURAL ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	utilization of the drafting software to develop an architectural Plan for the structure
CLR-2:	analysis of the behavior of 3D Moment Resistant RC Frames using STAAD Pro
CLR-3:	analysis of the elevated water tank subjected to static and lateral forces
CLR-4:	understanding of the behavior of determinate and indeterminate beams under moving loads using STAAD Pro
CLR-5:	gaining knowledge on the behavior of RC beam in FEM Software

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:	develop a plan for a residential and industrial buildings	3	3	-	2	-	-	-	-	3	-	-	-	3	3	3
CO-2:	report on the behavior of Moment Resistant RC Frames	3	3	-	2	-	-	-	-	3	-	-	-	3	3	3
CO-3:	analyse, design and detailing of the various components of the water tank	3	3	-	2	-	-	-	-	3	-	-	-	3	3	3
CO-4:	analyse the indeterminate structures using STAAD Pro	3	3	-	2	-	-	-	-	3	-	-	-	3	3	3
CO-5:	analyse the beam by using finite element software	3	3	-	2	-	-	-	-	3	-	-	-	3	3	3

Unit-1 - Development of Architectural Plan and Detailing — **12 Hour**

To develop a architectural plan for a G+3 residential building - The Plan developed includes the joinery locations - sunshade projections - parapet wall etc. -Calculation of Seismic loading using IS Codes - Calculation of Wind loading using IS Codes - Introduction to IS Codal Provisions for the design of RC Beam and Slab - Introduction to IS Codal Provisions for the design of RC Column and foundation.

Practice Session – 1 To develop a 3D Model in using Google sketch up for the building
Practice Session – 2 To develop a 3D Model in STAAD for the building for Static Analysis
Practice Session – 3 Application of Seismic Loads in STAAD for the 3D Frame
Practice Session – 4 Application of Wind Loads in STAAD for the 3D Frame
Practice Session – 5 Design of Columns, beams, slabs and foundation for the structure from STAAD output
Practice Session – 6 The STAAD output to be verified with IS Codal provisions

Unit-2 - Calculation and Application of Lateral Loads — **12 Hour**

To develop a General Architectural drawing for a industrial building - The Plan developed includes the rolling shutter - joinery locations, sunshade projections etc. - Calculation of Wind Loads using IS Codes- Calculation of Seismic Loads using IS Codes - Introduction to IS Codal Provisions for the design of stanchions - Pedestal and foundations - Introduction to IS Codal Provisions for the design of Truss and Purlins.

Practice Session – 7 To develop a 3D Model in STAAD for the building for stanchions, girt, bracings etc.,
Practice Session – 8 To develop a 3D Model in STAAD for the building for Rafter and purlins.
Practice Session – 9 To develop a 3D Model in STAAD for the building for Wind Loads
Practice Session – 10 To develop a 3D Model in STAAD for the building for Seismic Loads
Practice Session – 11 Design of Stanchions, Purlins, Truss, Pedestal and foundation for the truss.
Practice Session – 12 The STAAD output to be verified with IS Codal provisions

Unit-3 - Calculation of Load and Application of Water tank	***12 Hour***
Develop a model for an elevated circular Water Tank on staging for a capacity of 2 lakh litres - Determine the various static loads on the water Tank - Calculation of Wind loads on the Water Tank Manually - Calculation of Seismic loads on the Water Tank Manually - Introduction to IS Codal Provisions for the design of combined raft foundation - Introduction to IS Codal Provisions for the design of Ring beam and tank walls.	
Practice Session – 13 To develop a 3D Model in STAAD for the Water Tank *Practice Session – 14 To develop a 3D Model in STAAD for the Water Tank* *Practice Session – 15 Application of Seismic loads on the Water Tank in STAAD.* *Practice Session – 16 Application of Wind loads on the Water Tank in STAAD.* *Practice Session – 17 Design of Beams, Columns and Ring Beams and tie Bracings in STAAD.* *Practice Session – 18 The STAAD output to be verified with IS Codal provisions*	
Unit-4 - Introduction and Application of IRC Loads In Beam	***12 Hour***
Introduction to IRC (Indian Roads Congress) train of loads – provisions in codes, Arrangement of loads to get maximum bending moment and shear force - Conversion of track loads to equivalent uniformly distributed loads - Understanding the output and charting the maximum values sections-wise and arriving at the absolute maximum. Maximum values sections-wise and arriving at the absolute maximum - maximum values sections-wise and arriving at the absolute maximum - Validation of results manually - Understanding the output and charting the maximum values sections-wise and arriving at the absolute maximum. Validation of results manually - Validation of results manually for simply supported beams with track loads - Determination absolute maximum BM and SF - Understanding analysis options Understanding the output and charting the maximum values sections-wise and arriving at the absolute maximum - Validation of results manually Understanding the output and charting the maximum values sections-wise and arriving at the absolute maximum - understanding analysis options Validation of results manually	
Practice Session – 19 Simply supported beams. Modeling of point wheel loads as per STAAD Understanding analysis options *Practice Session – 20 Simply supported beams. Modeling of track wheel loads as per STAAD Understanding analysis options Understanding the output and charting the* *Validation of results manually for simply supported beams with point wheel loads, Determination absolute maximum BM and SF, Understanding the output and charting the* *Practice Session – 21 Balanced Cantilever beams Modeling of point wheel loads as per STAAD Understanding analysis options* *Practice Session – 22 Two span continuous beams Modeling of point wheel loads as per STAAD Understanding analysis options* *Practice Session – 23 Balanced Cantilever beams Modeling of point track loads as per STAAD* *Practice Session – 24 Two span continuous beams Modeling of point track loads as per STAAD*	
Unit-5 - Introduction to Finite Element Software	***12 Hour***
Introduction about Pre-processing and Post processing of Finite element software - Introduction to modelling, material nonlinearity -contact modelling, Meshing. Understanding analysis field output options and find the bending moments and shear forces - To understand the interaction between concrete and steel rebar - To understand the concrete damage plasticity behavior and find the ultimate load and deflection of concrete beam- Meshing of concrete cube of size 100 mm -Understand the output and find the load carrying capacity of concrete cube.	
Practice Session – 25 To Analyse a two-span continuous beam using 2 D planar section and draw the bending moment and shear force diagram *Practice Session – 26 To model a 3 D RCC beam using Finite element software* *Practice Session - 27 To analyse a 3 D RCC beam using Finite element software* *Practice Session – 28 Draw the load vs deflection curve under static loading for the RCC Beam* *Practice Session – 29 To Model a 3 D concrete cube of size 100 mm using Finite element software* *Practice Session – 30 To find the compressive strength of different grades of concrete*	

Learning Resources	1. *Unnikrishna Pillai.S, Devdas Menon, Reinforced Concrete Design, 5th ed., Tata McGraw, 2003.* 2. *Subramanian.N, Design of Reinforced Concrete Structures, Oxford University Press, 2013.* 3. *Subramanian.N, Design of Steel Structures, Oxford University Press, 2013.* 4. *Hibbeler R.C., Structural Analysis, 9th ed., Pearson, 2018*	5. *Ramamrutham.S, Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company. 2015.* 6. *https://www.youtube.com/watch?v=V855oetZK-o* 7. *https://www.youtube.com/watch?v=cu-NqKqNq2c*

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%*	-	-	*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. N. Parthasarathi, SRMIST*

Course Code	21CEE417J	Course Name	COMPUTER APPLICATION IN EARTHQUAKE RESISTANT STRUCTURES	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*understand the fundamentals of earthquake and learn to model 2D frames*
CLR-2:	*understand the principles of Single Degree of Freedom (SDOF) system and learn to model 3D frame using software*
CLR-3:	*apply Multi Degree of Freedom System (MDOF) and Response spectrum analysis of multi storey frame*
CLR-4:	*apply structural dynamics principles to the analysis of structures, Design members and frames with emphasis on ductile detailing and to apply time history analysis*
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 to model RCC frames*	*3*	-	-	-	-	-	*3*	*2*	-	-	-	*2*	*3*	*3*	*3*
CO-2:	*analyze single degree moment resistant frame for free and forced vibrations and to model 3D frame*	*3*	*3*	-	*2*	-	-	-	-	-	-	-	-	*3*	*3*	*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 and carry out Response spectrum analysis*	*3*	*3*	*3*	*2*	-	-	-	*2*	-	-	-	-	*3*	*3*	*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*	*3*	*3*
CO-5:	*able to suggest assessing techniques and retrofitting techniques for structures*	*3*	-	*3*	-	*3*	*3*	*2*	*2*	-	-	-	*2*	*3*	*3*	*3*

Unit-1 - Introduction to Earthquake Engineering	***12 Hour***
Earthquake – Introduction, Magnitude and Intensity - Ground Motions– Idealization of structures –Types of Loading and Analysis, Characteristics of Dynamic Load - Discretization. Practice 1: Modelling of 2D reinforced concrete structure using STAAD.Pro connect. Practice 2: Analysis of 2D reinforced concrete structure with Dead and Live load using STAAD.Pro connect	
Unit-2 – SDOF – Single Degree of Freedom Systems	***12 Hour***
Single Degree of freedom (SDOF) systems – Introduction - Equation of motions - Free and Forced vibrations – Undamped and Damped Systems - Simple Problems, Practice 3: Modelling of 3D reinforced concrete multi storeyed structure using STAAD.Pro connect. Practice 4: Modelling of 3D reinforced concrete multi storeyed structure using ETABS.	
Unit-3 - Multiple Degree of Freedom Systems and Design Seismic Forces	***12 Hour***
Introduction to Systems with two degrees and Three degree of freedom – Computation of Stiffness and mass matrix – Modal Super position method – Mode shape, Seismic Load calculations, Design seismic forces by Equivalent lateral force method as per IS1893 (Part 1): 2016, Practice 5: Response spectrum analysis of 3D reinforced concrete multi storeyed structure using STAAD.Pro connect as per IS1893 (Part 1): 2016.	
Unit-4 - Dynamic Analysis and Ductile Detailing	***12 Hour***
Dynamic Analysis – Determination of Displacement and Drift as per IS1893 (Part 1):2016. Ductile detailing requirements of Beam, Column, frame as per IS 13920: 2016 *Practice 6: Time history analysis of 3D reinforced concrete multi storeyed structure using ETABS.*	
Unit-5 - Damage Assessment and Seismic Retrofitting	***12 Hour***
Damage Assessment – Procedure – Nondestructive Testing, Retrofitting – Local – Global, Structural Control Systems – Passive control – Active Control, Smart materials.	

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 pra0ctice", 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 (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%*	*30%*	*-*
Level 4	*Analyze*	*20%*	*-*	*-*	*20%*	*30%*	*-*
Level 5	*Evaluate*	*10%*	*-*	*-*	*15%*	*-*	*-*
Level 6	*Create*	*10%*	*-*	*-*	*15%*	*-*	*-*
	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	21CEE418J	Course Name	COMPUTER APPLICATION IN SURFACE HYDROLOGY	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*understand precipitation analysis and plotting various curves in MS Excel*
CLR-2:	*address concepts related to water losses and create insights to watershed delineation using QGIS*
CLR-3:	*explore the concepts of runoff and plotting hydrographs in MS Excel*
CLR-4:	*comprehend reservoir routing and stream flow routing; Know watershed delineation using QGIS*
CLR-5:	*know various types of models; Explore HEC-RAS*

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 precipitation data using MS Excel*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-2:	*analyze water losses and derive watershed using QGIS*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-3:	*solve runoff estimation and hydrograph analysis using MS Excel*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-4:	*illustrate reservoir and stream flow routing; Derive watershed using QGIS*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-5:	*interpret various models; Work with HEC-RAS*	*3*	-	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*

Unit-1 - Hydrologic Cycle	***12 Hour***
Hydrologic cycle – Hydrologic equation – Precipitation - Mass curve – Hyetograph – DAD curve – IDF curves – Frequency analysis	
Unit-2 - : Water Losses	***12 Hour***
Water budget - Evaporation – Evaporation pans – Evapotranspiration - Blaney-Criddle method – Infiltration – Horton's equation – Infiltrometer – Phi index and W-index	
Unit-3 - : Runoff	***12 Hour***
Runoff estimation – Hydrograph components – Base flow separation – Unit hydrograph – S-curve – Synthetic unit hydrograph – Snyder's method	
Unit-4 - Flood routing	***12 Hour***
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	***12 Hour***
System concept in hydrology – Types of models – Types of watershed models – Artificial Neural Network - Network training algorithm – Back propagation- Advantages and limitations of ANN – HEC-RAS	

Practice -
Practice 1: Programming in MS Excel for deriving mass curve, hyetograph and DAD curve
Practice 2: Programming in MS Excel for deriving IDF curves and Frequency analysis
Practice 3: Programming in MS Excel for plotting Unit Hydrograph
Practice 4: Programming in MS Excel for plotting S-curve
Practice 5: Programming in MS Excel for deriving ISD method
Practice 6: Programming in MS Excel for deriving Muskingum method
Practice 7: Installation and overview of QGIS interface
Practice 8: Working with Google Earth and Quick map services
Practice 9: Extraction of Contour Maps using Google Earth
Practice 10: Extraction of DEM from Bhuvan, SRTM and CARTOSTAT
Practice 11: Deriving stream order using DEM
Practice 12: Deriving watershed using DEM
Practice 13: Installation and overview of HEC-RAS
Practice 14: Creating one dimensional geometry files
Practice 15: Working with boundary conditions and working for various time steps

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. *Duggal K.N. & Soni J.P., Elements of Water Resources Engineering, New Age International Publishers, 2011* 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 – Watershed Management: https://nptel.ac.in/courses/105101010/16* 7. *QGIS User manual pdf* 8. *HECRAS User Guide, Tutorial. https://www.youtube.com/channel/UCIJ0otLhqayjbYDwSewctdg (HEC RAS Tutorials*

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%*	-	-	*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	21CEE419J	Course Name	COMPUTER APPLICATION IN WATER RESOURCES ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*create insights into hydrometeorological variables, Google Earth and Quick map services*
CLR-2:	*understand concepts related to stream flow measurement; Create insights in raster and vector data using QGIS*
CLR-3:	*explore water resources planning and management; Explore different options in downloading DEM*
CLR-4:	*comprehend erosion and reservoir sedimentation; Know watershed delineation using QGIS*
CLR-5:	*know various types of models and create insights to watershed modeling tools; Explore HEC-RAS*

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:	*analyze hydrometeorological variables; Work with Google Earth and Quick map services*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-2:	*explain various options in stream flow measurement and work with raster/vector data using QGIS*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-3:	*execute water resources planning and management; Derive stream order using DEM*	*3*	-	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-4:	*illustrate erosion and reservoir sedimentation; Derive watershed using QGIS*	*3*	*3*	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-5:	*analyze various models and watershed modeling tools; Work with HEC-RAS*	*3*	-	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*

Unit-1 - Hydrometeorology	***12 Hour***
Scope of hydrometeorology - Constituents of the atmosphere – Meteorological variables – Temperature, Atmospheric pressure, Humidity, Wind - Vertical structure of the atmosphere - Wind and Wind belts	
Unit-2 - Stream Flow Measurement	***12 Hour***
Measurement of stage and velocity – Area-velocity method – Dilution technique – Electromagnetic method – Ultrasonic method – Stage-Discharge relationships – Hydrometry stations	
Unit-3 - Water Resources Planning and Management	***12 Hour***
India's water resources – Estimation of water requirement – Functional requirements of multipurpose projects – Process of project formulation – Planning and management strategies – Strategies for future	
Unit-4 - Erosion and Reservoir Sedimentation	***12 Hour***
Erosion processes – Estimation of sheet and channel erosion – Sediment yield from watersheds – Trap efficiency – Life of a reservoir – Reservoir sedimentation control	
Unit-5 - Systems & Models	***12 Hour***
System concept in hydrology – Types of models – Types of watershed models – Artificial Neural Network - Network training algorithm – Advantages and limitations of ANN – HEC-RAS	

Practice -
Practice 1: Installation of QGIS interface
Practice 2: Overview of QGIS interface
Practice 3: Working with Google Earth and Quick map services
Practice 4: Extraction of Contour Maps using Google Earth
Practice 5: Working with vector data in QGIS
Practice 6: Working with raster data
Practice 7: Analyzing the areas of influence with Thiesson polygon method
Practice 8: Extraction of DEM from Bhuvan, SRTM and CARTOSTAT
Practice 9: Deriving stream order using DEM
Practice 10: Deriving watershed using DEM
Practice 11: Making comprehensive map using QGIS
Practice 12: Installation of HEC-RAS
Practice 13: Overview of HEC-RAS
Practice 14: Creating one dimensional geometry files
Practice 15: Working with boundary conditions and various time steps

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* 8. *QGIS User manual pdf* 9. *HEC RAS User Guide, Tutorial. https://www.youtube.com/channel/UClJ0otLhqayjbYDwSewctdg (HEC RAS Tutorials*

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%*	-	-	*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	21CEE420J	Course Name	REMOTE SENSING APPLICATION IN CIVIL ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*identify the principles of Remote Sensing*
CLR-2:	*classify the various remote sensing products and its processing*
CLR-3:	*apply the concepts of data capturing, storing and analyzing using software*
CLR-4:	*study the basic data processing operations for solving real life problems*
CLR-5:	*impart the importance of remote sensing in various real-world applications*

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 principles and sensing process in Remote Sensing*	*3*	-	-	-	-	-	-	-	-	*3*	-	*3*	*3*	*3*	*3*
CO-2:	*examine various methods to derive information from satellite data*	*3*	-	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-3:	*analyze the data capturing and classification techniques using software*	*3*	-	-	-	*3*	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-4:	*evaluate the process of thematic map making using various preprocessing techniques*	*3*	-	*3*	-	-	-	-	-	-	-	-	*3*	*3*	*3*	*3*
CO-5:	*generate various thematic maps using the knowledge of remote sensing*	*3*	-	-	*3*	-	-	-	-	-	-	-	*3*	*3*	*3*	*3*

Unit-1 - Introduction to Remote Sensing	***12 Hour***
Introduction to Remote sensing - Remote sensing systems and processes - Practice 1 & 2: Interpretation of Toposheet - EMR interaction with atmosphere and earth surface features - Platforms and sensors - Sensor characteristics - Scanning mechanism - Practice 3 & 4: Stereoscopy and stereoscopic interpretation.	
Unit-2 - Remote Sensing Processes	***12 Hour***
Optical and thermal remote sensing - Microwave and Hyperspectral remote sensing - Practice 5 & 6: Spectral signature of common earth features - Visual interpretation keys - Visual interpretation of satellite image - Practice 7 & 8: Visual Interpretation of satellite images - Indian Remote sensing satellite series.	
Unit-3 - Data Handling Techniques	***12 Hour***
Image processing techniques - Image classification techniques - Practice 9 & 10: Image classification – Supervised and Unsupervised Techniques, Introduction to GIS Software - Projections and coordinate systems - Spatial and non-spatial data - Practice 11 & 12: Georeferencing and Digitization of point, line and polygon.	
Unit-4 - Data Processing	***12 Hour***
Data analysis: Spatial data analysis - non-spatial data analysis - Cartography and map types - Practice 13 & 14: Preparation of base map, Data input and output techniques - Spatial interpolation techniques - Practice 15 & 16: Extraction of topographic parameters and spatial analysis.	
Unit-5 - Applications of Remote Sensing	***12 Hour***
Digital terrain model - Digital surface model - Practice 17 & 18: Preparation of Land use and land cover map - Basics of UAS and Sensor calibration - UAS data formats - data acquisition and processing - Practice 19 & 20: Layout preparation.	

Learning Resources	1. *Patrick McHaffie, Sungsoon Hwang, Cassie Follett GIS: An Introduction to Mapping Technologies, CRC Press, Taylor & Francis Group, Boca Raton FL 2019.* 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. *John R. Jensen, Introductory Digital Image Processing: "A remote sensing perspective", Prentice Hall 6.*	6. *Floyd F. Sabins, Jr: "Remote Sensing Principles and Interpretation", Freeman and Co., San Franscisco, 2007.* 7. *Kang Tsung Chang, Introduction to Geographical Information System, Tata McGraw Hill, 7th edition, 2010.* 8. *Paul A. Longley, Micheal F. Goodchild, David J. Magaine David J. Magaine, David W Rhind. Geographical Information System, Vol. I & II, John Wiley & Sons.Inc1999.* 9. *NPTEL Course, Introduction to remote sensing, https://nptel.ac.in/courses/105108077/* 10. *NPTEL Course — Introduction to GIS, https://nptel.ac.in/courses/105102015/*

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. T. Mayamanikandan, Project Scientist, NCCR, Chennai, maya@nccr.gov.in*	1. *Dr. R. Kanmani Shanmuga Priya, Assistant Professor, Anna University, Chennai.*	1. *Dr. M. Kamalanandhini, SRMIST*
2. *Dr. Tune Usha, Scientist, NCCR, Chennai*	2. *Dr. K. Nagamani Scientist-D/ Head, Centre for Remote Sensing and Geoinformatics, Sathyabama Institute of Science and Technology, Chennai*	2. *Dr. S. Durga Devagi, SRMIST*

Course Code	21CEE421J	Course Name	GIS APPLICATIONS IN CIVIL ENGINEERING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*study the basic concepts of GIS*
CLR-2:	*explore the database management*
CLR-3:	*understand the various GIS analysis*
CLR-4:	*learn the advanced GIS techniques*
CLR-5:	*instill the role of engineers in society, code of ethics and socio-politics of technology and engineering*

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:	*acquire the knowledge on GIS*	*3*	-	-	-	*3*	-	-	-	*3*	-	-	-	*3*	*3*	*3*
CO-2:	*enumerate data capturing and storing*	*3*	-	-	-	*3*	-	-	-	*3*	-	-	-	*3*	*3*	*3*
CO-3:	*analyze the knowledge*	*3*	-	-	-	*3*	-	-	-	*3*	-	-	-	*3*	*3*	*3*
CO-4:	*illustrate DEM, Interpolation Techniques*	*3*	-	-	-	*3*	-	-	-	*3*	-	-	-	*3*	*3*	*3*
CO-5:	*apply the various applications of GIS*	*3*	-	-	-	*3*	-	-	-	*3*	-	-	-	*3*	*3*	*3*

Unit-1 - GIS	***12 Hour***
Introduction to GIS - Components of GIS – GIS Software's - Data sources Practice 1: Importing GIS Data source - Coordinate System – Projection - UTM -Spatial Referencing - methods - Practice 2: Georeferencing - Data input and output methods - Maps-Types – GIS Modules - Meta Data - Practice 3: Geodatabase Creation and Digitization	
Unit-2 - GIS Data	***12 Hour***
Data types - Data Representations - Practice 4: Lay out preparation - Data Models - Data Compression– Practice 5: – Data Conversion - Data Quality - Topology- Measurement – area- Length - Perimeter - Practice 6 Preparation of Base map	
Unit-3 - Data Analysis	***12 Hour***
Spatial data analysis - Query – Buffering - Practice 7: Buffer analysis - Reclassification - Overlay Analysis Practice 8: Overlay Operations – Raster analysis Multi-Criteria Analysis- Practice 9 : Raster data analysis	
Unit-4 - Dem and Spatial Interpolation	***12 Hour***
Digital elevation Model, Sources - Generation – Parameters – Slope- Aspect, Applications, Practice 10: DEM Analysis Slope- Aspect - TIN - Generation - Uses - Practice 11: TIN analysis – Spatial interpolation – Types - Practice 12: IDW interpolation	
Unit-5 - Applications of GIS	***12 Hour***
Land use and Landcover analysis- GIS in Resource Mapping - Practice 13: Change detection – GIS in Groundwater Potential Zones – GIS in Flood mapping – GIS in Agriculture - Practice 14: – Drainage delineation from DEM - GIS in Landslide - Practice 15: Inundation study with DEM	

Learning Resources	1. *Paul Bolstad," GIS Fundamentals: A First Text on Geographic Information Systems" 5th Edition, Eider Press, Minnesota 2016.* 2. *Anji Reddy .M, "Remote sensing and Geographical information system", B.S Publications, 2011.* 3. *Burrough P.A, "Principles of GIS for Land Resources Assessment", Oxford Publication,1980*	4. *Kang Tsung Chang, Introduction to Geographical Information System, Tata McGraw Hill, 7th edition, 2010.* 5. *Lo, C.P., and Albert K.W. Yeung. 2009. Concepts and Techniques of Geographic Information Systems, 2nd Edition. PHI Learning*

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. V. S. Jeyakanthan, Scientist, NIH, Kakinada*	1. *Dr Girish Gopinath, Associate professor, KUFOS University, Cochin*	1. *Dr. Aparna S Bhaskar, SRMIST*
2. *Dr. Sarunjith K. J., Scientist, NCSCM, Chennai*	2. *Dr. Gnanappazham L, Associate Professor, IIST, Thiruvananthapuram*	2. *Dr Satish Kumar J, SRMIST*

Course Code	21CEE422J	Course Name	BUILDING INFORMATION MODELLING	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*understand the concept of BIM*
CLR-2:	*identify the focus area for the use of the BIM tools in construction*
CLR-3:	*analyze the basic concepts of modelling of building*
CLR-4:	*explore the advanced level of BIM tools*
CLR-5:	*create the building model with MEP and Scheduling using 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:	*acquire the knowledge of BIM techniques*	*3*	-	*2*	-	-	-	-	-	-	-	*3*	-	*3*	*3*	*3*
CO-2:	*apply the knowledge of assess your project needs*	*3*	-	*2*	-	-	-	-	-	-	-	*3*	-	*3*	*3*	*3*
CO-3:	*evaluate comprehensive knowledge on managing BIM tools*	*3*	-	*3*	-	*3*	-	-	-	-	-	*2*	-	*3*	*3*	*3*
CO-4:	*accrue the knowledge of collaborative models of BIM*	*3*	-	*3*	-	*2*	-	-	-	-	-	*2*	-	*3*	*3*	*3*
CO-5:	*explore the advanced level of BIM tool*	*3*	-	*2*	-	*2*	-	-	-	-	-	*2*	-	*3*	*3*	*3*

Unit-1 - BIM Introduction	***12 Hour***
Introduction to BIM - Fundamental of BIM Approach - Application of BIM - Optimizing BIM Processes – BIM Execution Plan - Identifying and Planning BIM Uses	
Unit-2 - BIM Tools and Modelling	***12 Hour***
Creating the vision - Opening line of communication - Design structure matrix - Constructability review - Revit schedules for Estimating - Sustainability Analysis	
Unit-3 - BIM Collaboration	***12 Hour***
Defining Project Organization – BIM Site Coordination Activity Tracking – System Installation for management and Verification - Collaborating with a Team - Managing the Coordination Process	
Unit-4 - BIM Applications	***12 Hour***
BIM for Owners, Architects & Engineers - Contractors, Sub-contractors and Fabricators - BIM Scheduling - Field issue management - BIM and Safety - Document control	
Unit-5 - BIM Integrated Project	***12 Hour***
Artifact and constant deliverables – Handover information - new culture of innovation – AI in construction & Virtual walk-throughs – Sustainable construction – Case studies	

Practice -

Practice 1: Introduction to building modeling software	*Practice 6: Curtain wall and Wall Openings, Doors and Windows*	*Practice 11: Extrusion of elements*
Practice 2: Create level, grids and sections	*Practice 7: Methods of modelling of floors and massing*	*Practice 12: Modelling of structural components*
Practice 3: Modify and edit tools	*Practice 8: Methods of modelling of roofs and massing*	*Practice 13: Adding MEP to the building model*
Practice 4: Family creation	*Practice 9: Staircase and railings*	*Practice 14: Scheduling and estimation*
Practice 5: Creation of wall and its types, Wall articulation with materials	*Practice 10: Annotations – Dimensions, Texts, Views, Cutoffs, Tags and legends*	*Practice 15: Software output*

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. *Robert Yori, Marcus Kim, Lance Kirby Mastering Autodesk Revit 2020, John Wiley & Sons, Inc., Indianapolis, Indiana, 2020* 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 (45%)		*Life-Long Learning CLA-2 (15%)*			
		Theory	*Practice*	*Theory*	*Practice*	*Theory*	*Practice*
Level 1	*Remember*	*20%*	-	-	*20%*	*20%*	-
Level 2	*Understand*	*30%*	-	-	*20%*	*30%*	-
Level 3	*Apply*	*30%*	-	-	*30%*	*30%*	-
Level 4	*Analyze*	*20%*	-	-	*30%*	*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, R KMNNN@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. L. Krishnaraj, SRMIST*

Course Code	21CEE423J	Course Name	COMPUTER APPLICATION IN CONSTRUCTION ENGINEERING AND MANAGEMENT	Course Category	E	PROFESSIONAL ELECTIVE	L	T	P	C
							2	0	2	3

Pre-requisite Courses	*Nil*	Co- requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*	Data Book / Codes / Standards		*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:	*model building information model*
CLR-5:	*infer 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:	*identify the basic requirements for planning the construction project*	*2*	*3*	-	-	-	-	-	-	-	-	*2*	*3*	*3*	*3*	*3*
CO-2:	*calculate the resources required for construction project*	*2*	*3*	-	-	-	-	-	-	-	-	*2*	*3*	*3*	*3*	*3*
CO-3:	*analyze the competence to determine the total project duration*	*2*	*3*	-	-	-	-	-	-	-	-	*2*	*3*	*3*	*3*	*3*
CO-4:	*model building information model*	*2*	*3*	-	-	-	-	-	-	-	-	*2*	*3*	*3*	*3*	*3*
CO-5:	*infer the applications of emerging technologies for construction project management problems*	*2*	*3*	-	-	-	-	-	-	-	-	*2*	*3*	*3*	*3*	*3*

Unit-1 - Construction Planning — ***12 Hour***

Construction planning, work break down structure, phases and life cycle of project management, computer applications – drawing, modelling, project management, simulation, and facility management, Essential aspects of National Building Code, Elements of construction drawing, international standards for project management – Project Management Body of Knowledge and IS/ISO 21500:2015 guidelines on project management.

Unit-2 - Construction Resource Management — ***12 Hour***

Relevant Indian standards for the construction materials, storage, and stacking. Economic order of quantity, Materials requirement, Materials purchasing – aspects of procurement of goods manual 2022, Labor and labor classes, equipment and equipment classification, significance of database management system in enterprise resource management

Unit-3 - Time Management — ***12 Hour***

Scheduling methods for construction project – Critical path method (numerical problem), Program Evaluation Review Technique (numerical problem), Critical chain method, and Line of Balance method. Resource allocation, Resource constrained scheduling problem, Resource leveling problem.

Unit-4 - Construction Project Monitoring and BIM — ***12 Hour***

Construction project performance indicators, Earned value management, Tracking, Unmanned aerial system (UAS), Change control system, Building Information Modelling (BIM), Applications of BIM for new building projects. Applications of BIM for existing building projects.

Unit-5 - Emerging Technologies for Construction Engineering and Management — ***12 Hour***

4D Simulation, Industrial Internet of Things (IIoT), Building occupancy sensors and actuators, Essentials of 3D printing, Optimization techniques for construction engineering and management problems, Applications of machine learning (ML), Applications of deep learning (DL), Applications of neural networks (NN) for construction engineering and management problems, Futuristic perspective of construction engineering and management.

Practice	
Practice 1 – Drafting software user interface and important tools	*Practice 11 & 12 – Resource allocation and scheduling of G+2 residential building project using scheduling software*
Practice 2 – Drawing plan, sectional elevation of G+2 residential building	*Practice 13 – Tracking of G+2 residential building project, Bottom-up estimation*
Practice 3 & 4 – Quantity estimation of G+2 residential building and MS Excel	*Practice 14 – Revit 2022 – User interface and important tools*
Practice 5 – Rate analysis as per DAR 2021 using MS Excel, Analysis of rates using Delhi Analysis of Rates (DAR) 2021	*Practice 15 & 16 – Development of G+2 residential building BIM*
Practice 6 – Estimation of resources: manpower and machineries using MS Excel	*Practice 17 – Quantity takeoff of G+2 residential building project*
Practice 7 & 8 – Determination of activities duration and tradeoff between duration and cost	*Practice 18 – ML model to predict house prices using Google Colab*
Practice 9 – Scheduling software user interface and important tools	*Practice 19 - DL model to classify information using Google Colab*
Practice 10 – Creation of calendars, resources, and activities using scheduling software	*Practice 20 - NN model to predict house prices using Google Colab*

Learning Resources		
	1. *Construction Project Management: Theory and Practice, 2015, Kumar Neeraj Jha, Pearson publication.*	5. *Project Management Institute. (2017). A guide to the Project Management Body of Knowledge (PMBOK guide) (6th Ed.). Project Management Institute.*
	2. *National Building Code, 2016, Bureau of Indian Standards*	6. *IS/ISO 21500:2012 Guidance on project management, Bureau of Indian Standards*
	3. *Manual for procurement of goods, 2022, Ministry of Finance, Department of Expenditure, Government of India*	7. *Artificial Intelligence with Python, 2017, Prateek Joshi, Packt publication.*
	4. *Analysis of Rates for Delhi, Vol -1, 2021, Central Public Works Department, Authority of Director General, New Delhi, Government of India.*	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 (45%)		*Life-Long Learning CLA-2 (15%)*			
		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, L&T Pvt. Ltd, Chennai. amar.changeagent@gmail.com*	1. *Dr. S. Geetha, Professor, Department of Civil Engineering, Rajalakshmi Engineering College, Chennai, geetha.s@rajalakshmi.edu.in*	1. *Dr. S. Gopinath, 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. L. Krishnaraj SRMIST*

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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